

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

**B721/01**

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

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

**TUESDAY 9 JUNE 2015: Afternoon**

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

**MODIFIED ENLARGED**

<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:**  
**A copy of the Periodic Table**

**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**

**The quality of written communication is assessed in questions marked with a pencil (.**

**A list of equations can be found on pages 4–5.**

**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.**

**Any blank pages are indicated.**

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## **EQUATIONS**

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

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

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

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

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

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

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

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

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

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

**force = mass × acceleration**

**weight = mass × gravitational field strength**

**work done = force × distance**

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

**power = force × speed**

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

**momentum = mass × velocity**

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

**GPE = mgh**

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

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

**Answer ALL the questions.**

**SECTION A – Module B3**

**1 Look at the table.**

**It shows the results of an investigation into exercise and pulse rate.**

<b>STUDENT</b>	<b>PULSE RATE IN BEATS PER MINUTE</b>				
	<b>1 min of exercise</b>	<b>2 min of exercise</b>	<b>3 min of exercise</b>	<b>4 min of exercise</b>	<b>5 min of exercise</b>
<b>1</b>	<b>88</b>	<b>98</b>	<b>102</b>	<b>110</b>	<b>110</b>
<b>2</b>	<b>92</b>	<b>96</b>	<b>103</b>	<b>115</b>	<b>118</b>
<b>3</b>	<b>87</b>	<b>100</b>	<b>112</b>	<b>112</b>	<b>130</b>
<b>4</b>	<b>93</b>	<b>109</b>	<b>115</b>	<b>120</b>	<b>125</b>
<b>5</b>	<b>90</b>	<b>93</b>	<b>101</b>	<b>112</b>	<b>112</b>
<b>Mean</b>	<b>90</b>	<b>99</b>	<b>107</b>	<b>114</b>	

**(a) (i) Calculate the mean pulse rate of the five students after five minutes of exercise.**

**mean pulse rate = \_\_\_\_\_ beats per minute**  
**[1]**

- (ii) Before the students exercised, they measured their resting pulse rate.

Describe how to measure resting pulse rate.

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[2]

- (iii) The mean resting pulse rate measured in this investigation is 66 beats per minute.

What conclusions can be made about the effects of exercise on pulse rate in these five students?

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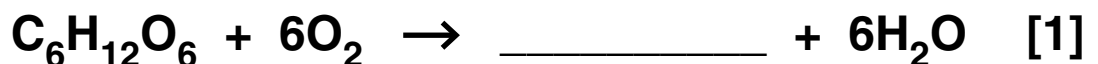
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[2]

- (b) (i) Aerobic respiration is important during exercise.

Finish the symbol equation for aerobic respiration.



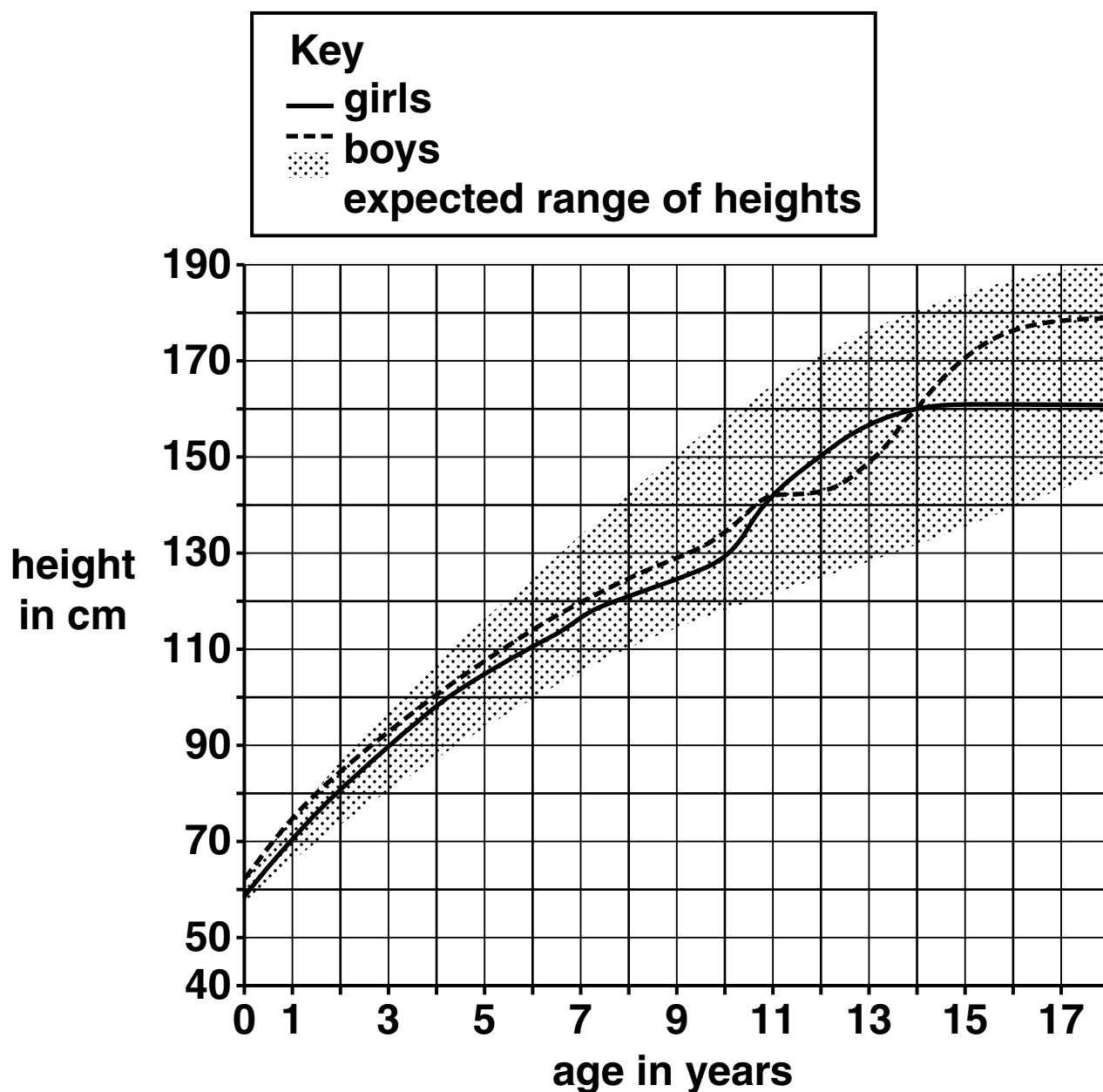
- (ii) Why is blood important for aerobic respiration?

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[1]

## 2 Look at the graph.

It shows growth in boys and girls up to the age of 18 years.



- (a) (i) Write down the age range when girls are taller than boys.

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



- (ii) Doctors would need to monitor the height of a nine year old boy who was 110 cm tall.

Why would doctors need to monitor this nine year old boy?

Put a tick (✓) in the box next to the best answer.

He is smaller than a nine year old girl.

☐

He is outside the expected range of heights.

☐

He should be 130 cm tall.

☐

He is shorter than the average height of a four year old boy.

☐

[1]

- (b) Genes are important in controlling the height of a person.

Dwarfism can be caused by a gene mutation.

What is a gene mutation?

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

**(c) Genes are made of the chemical DNA.**

**The structure of DNA was worked out by Watson and Crick.**

**Explain why it was important for their model of DNA to be peer reviewed.**

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**[2]**

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### **3 Look at the picture of a firefly.**

**The firefly is able to give out flashes of bright light to attract a mate.**

**Just after dark is the best time to see fireflies flashing light.**

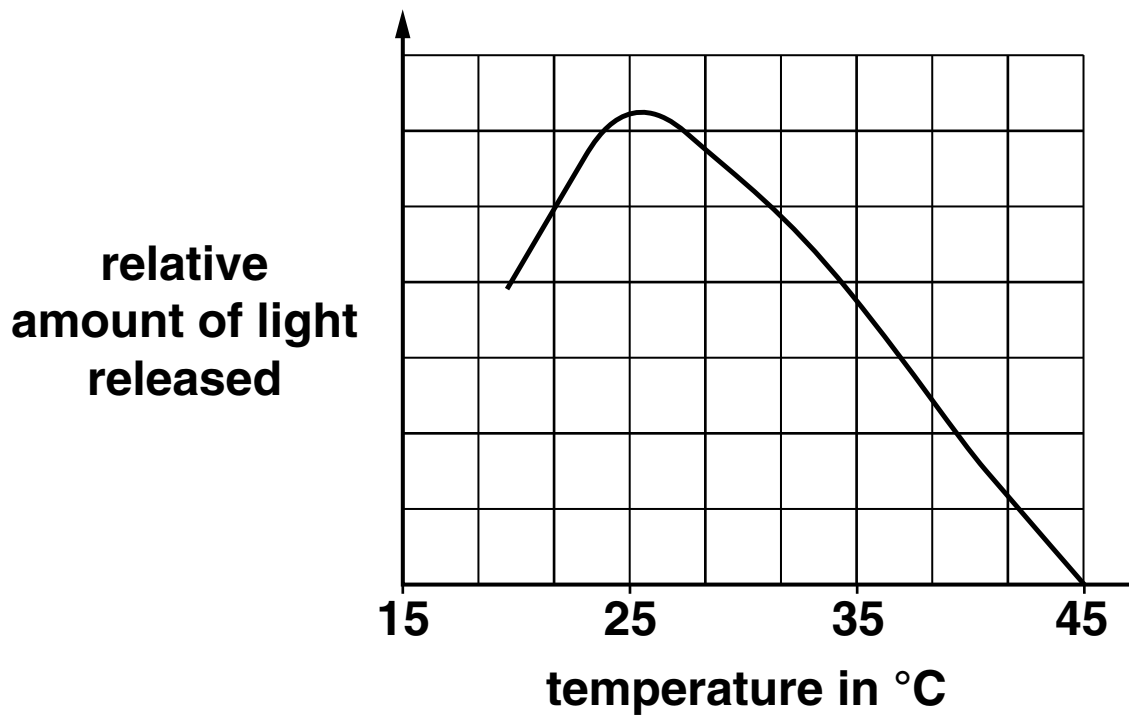


**The reaction that releases light involves the breakdown of a chemical.**

**An enzyme called luciferase is needed for this reaction.**

**Look at the graph.**

**It shows how temperature affects the reaction that releases light.**



- (a) Use the graph to DESCRIBE how luciferase is affected by temperature. Explain why luciferase is the ONLY enzyme that will catalyse this reaction.**



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[6]

**(b) The ancient Chinese captured fireflies in transparent containers, using them as lanterns.**

**They bred the fireflies until they produced the brightest lanterns.**

**Describe how the ancient Chinese could selectively breed fireflies that were the best for lanterns.**

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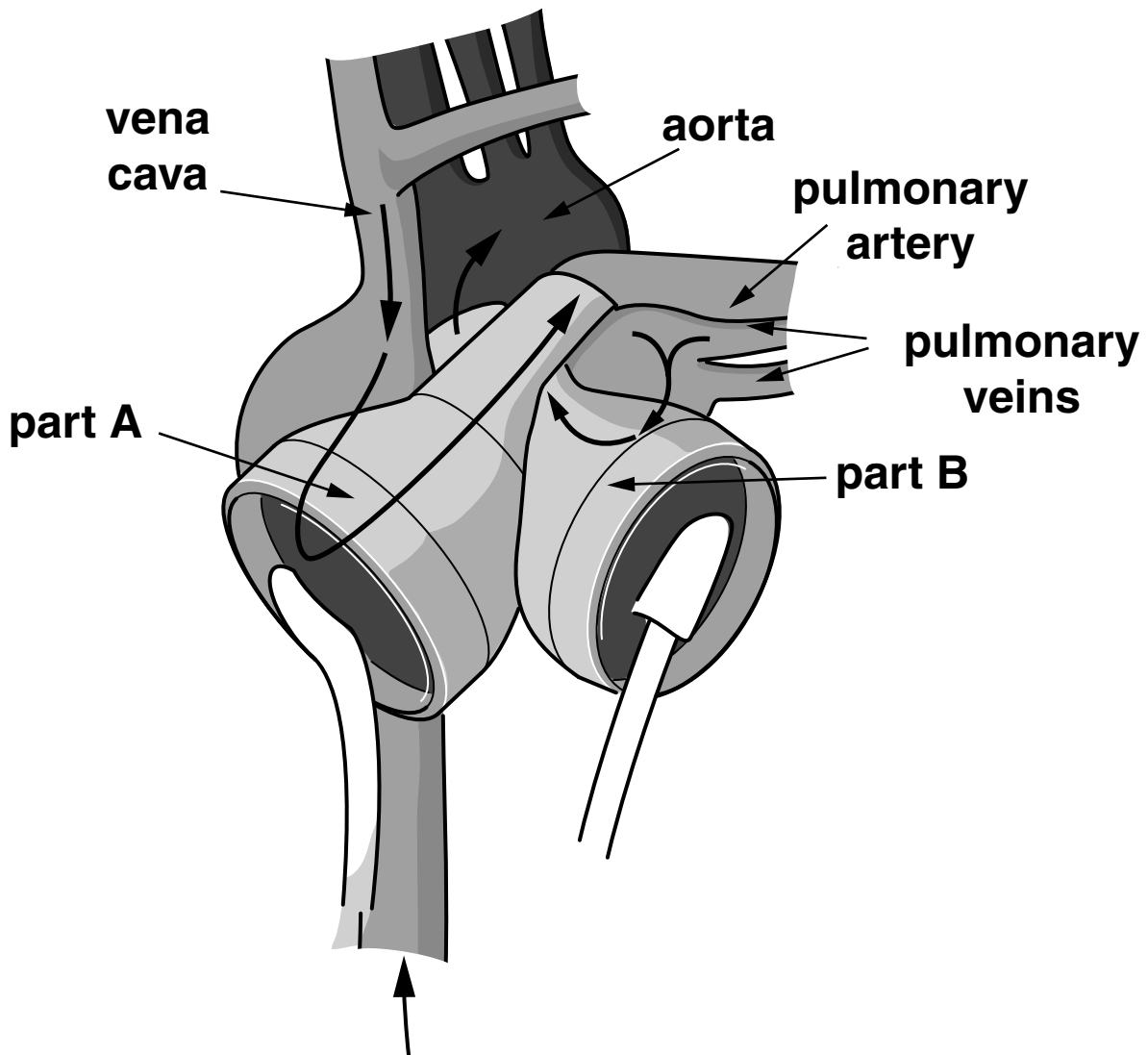
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**[3]**

**4 Look at the picture.**

**It shows an artificial heart.**



**(a) Part A and part B in the artificial heart pump blood to different places.**

**Part B has to work the hardest.**

**Explain why.**

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**[2]**



**(b) Artificial hearts do not respond to changes in the body.**

**They need to have an external control.**

**Explain why this external control is important during exercise.**

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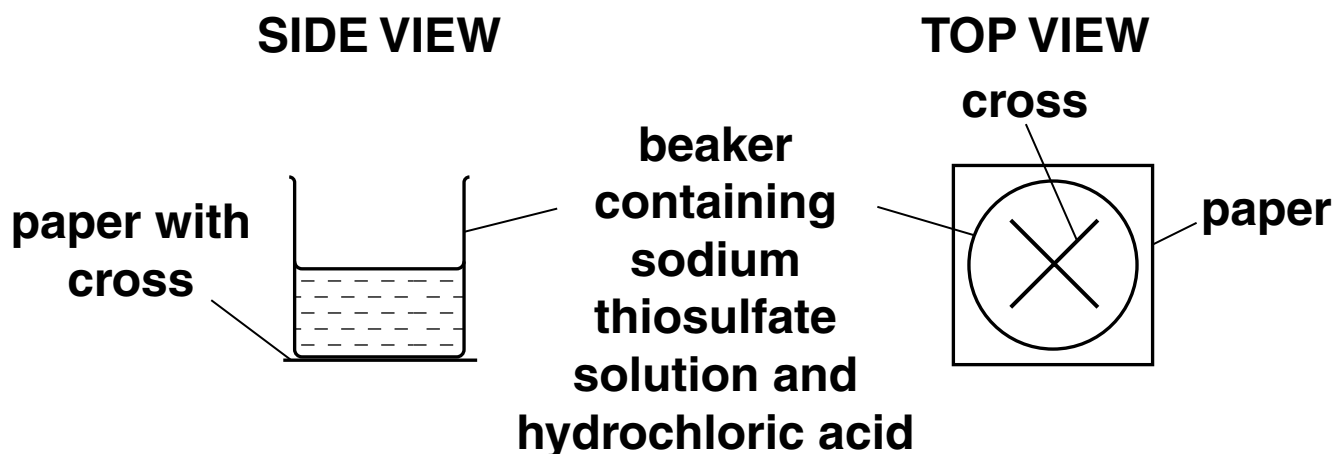
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**[2]**

## SECTION B – Module C3

- 5 Harneet and Mike investigate the reaction between sodium thiosulfate and hydrochloric acid.

Look at the diagram. It shows their experiment.



Harneet and Mike look down at the cross.

The liquid in the beaker goes cloudy.

After a time they cannot see the cross on the paper.

Harneet and Mike measure this time. This is the reaction time.

They do the experiment four times at 20°C.

They use four different concentrations of sodium thiosulfate solution, A, B, C and D.

**Look at their results.**

<b>Concentration</b>	<b>Reaction time in seconds</b>
<b>A</b>	<b>43</b>
<b>B</b>	<b>72</b>
<b>C</b>	<b>124</b>
<b>D</b>	<b>61</b>

**(a) Which is the MOST CONCENTRATED solution of sodium thiosulfate?**

**Choose from A, B, C or D.**

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

**(b) Changing the concentration of sodium thiosulphate changes the rate of this reaction.**

**Write about TWO OTHER ways of speeding up this reaction.**

\_\_\_\_\_  
\_\_\_\_\_

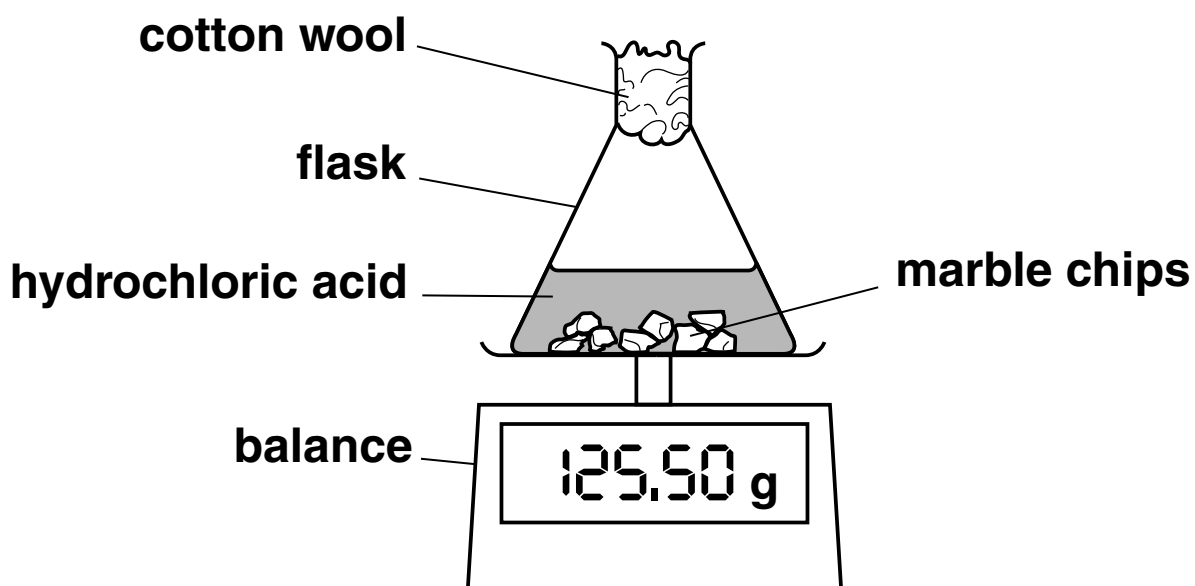
\_\_\_\_\_ [2]

**(c) Eventually the reaction stops.**

**Explain why.**

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

**(d) Harneet also investigates the reaction of marble chips with hydrochloric acid.**



**The total mass of the flask and its contents decreases during the experiment.**

**Harneet records this decrease every 4 minutes.**

**She does the experiment with large marble chips.**

**She repeats the experiment with small marble chips.**

**Look at her results.**

<b>Time in minutes</b>	<b>LOSS IN MASS IN g</b>	
	<b>Large marble chips</b>	<b>Small marble chips</b>
<b>0</b>	<b>0</b>	<b>0</b>
<b>4</b>	<b>0.4</b>	<b>0.8</b>
<b>8</b>	<b>0.8</b>	<b>1.4</b>
<b>12</b>	<b>1.2</b>	<b>1.6</b>
<b>16</b>	<b>1.5</b>	<b>1.7</b>
<b>20</b>	<b>1.7</b>	<b>1.7</b>

- (i) Harneet wants to choose the best way to present her results.**

**How should she present her results?**

**Choose from the list.**

**bar chart**

**histogram**

**line graph**

**pie chart**

**answer \_\_\_\_\_**

**[1]**

- (ii) Harneet thinks that the reaction is faster with SMALL marble chips.

Is she correct?

Use her results to give TWO reasons to explain your answer.

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[2]

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**6 This question is about different forms of carbon.**

**Look at the diagrams opposite. They show three different forms of carbon.**

**(a) Write down the name of the form of carbon labelled X.**

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

**(b) Graphite is used in pencil leads.**

**One PHYSICAL PROPERTY of graphite is that it is opaque.**

**Write down ONE OTHER physical property of graphite.**

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

**(c) Ball-shaped fullerenes can be used in new drug delivery systems.**

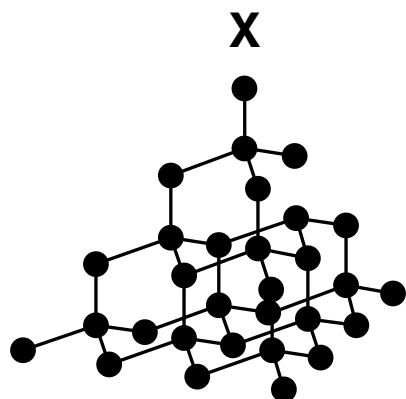
**Explain why.**

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

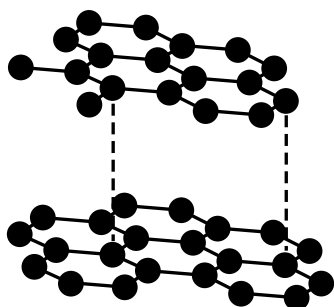


## Key

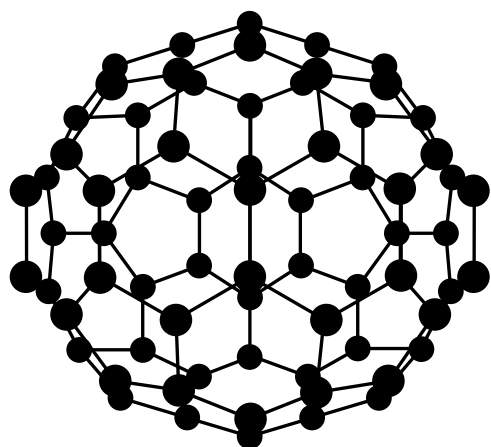
● = carbon atom



## graphite



## Buckminster fullerene



**7 David is investigating some liquid fuels.**

**He investigates the energy given out by four different fuels.**

**He burns 1.0 g of fuel each time.**

**He uses the energy released to heat 25 cm<sup>3</sup> of water.**

**Look at his table of results.**

<b>Fuel</b>	<b>Temperature of water at start in °C</b>	<b>Temperature of water at end in °C</b>
<b>A</b>	<b>19</b>	<b>44</b>
<b>B</b>	<b>21</b>	<b>41</b>
<b>C</b>	<b>18</b>	<b>48</b>
<b>D</b>	<b>20</b>	<b>46</b>

**(a) Describe, using a diagram, the experiment David does to obtain these results.**

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**[3]**

**(b) Look at David's results.**

<b>Fuel</b>	<b>Temperature of water at start in °C</b>	<b>Temperature of water at end in °C</b>
<b>A</b>	<b>19</b>	<b>44</b>
<b>B</b>	<b>21</b>	<b>41</b>
<b>C</b>	<b>18</b>	<b>48</b>
<b>D</b>	<b>20</b>	<b>46</b>

**Which fuel gives out MOST energy?**

**Explain your choice.**

\_\_\_\_\_

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

**(c) Fuel B is ethanol.**

**Ethanol burns in oxygen.**

**Carbon dioxide and water are made.**

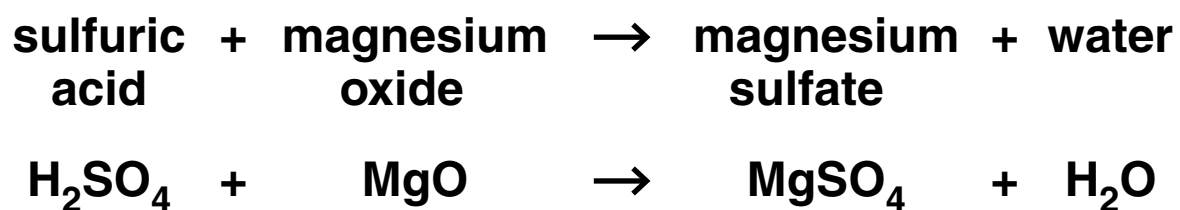
**Write a WORD EQUATION for this reaction.**

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

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**8 Megan is making some magnesium sulfate.**

**Look at the equations.**



**(a) Write down the formula of one REACTANT in this reaction.**

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

(b) Look at the table.

It shows some information about the compounds involved in making magnesium sulfate.

COMPOUND	FORMULA	RELATIVE FORMULA MASS, $M_r$
sulfuric acid	$\text{H}_2\text{SO}_4$	98
magnesium oxide	$\text{MgO}$	40
magnesium sulfate	$\text{MgSO}_4$	120
water	$\text{H}_2\text{O}$	18

Calculate the ATOM ECONOMY of this reaction.

Water is a waste product.

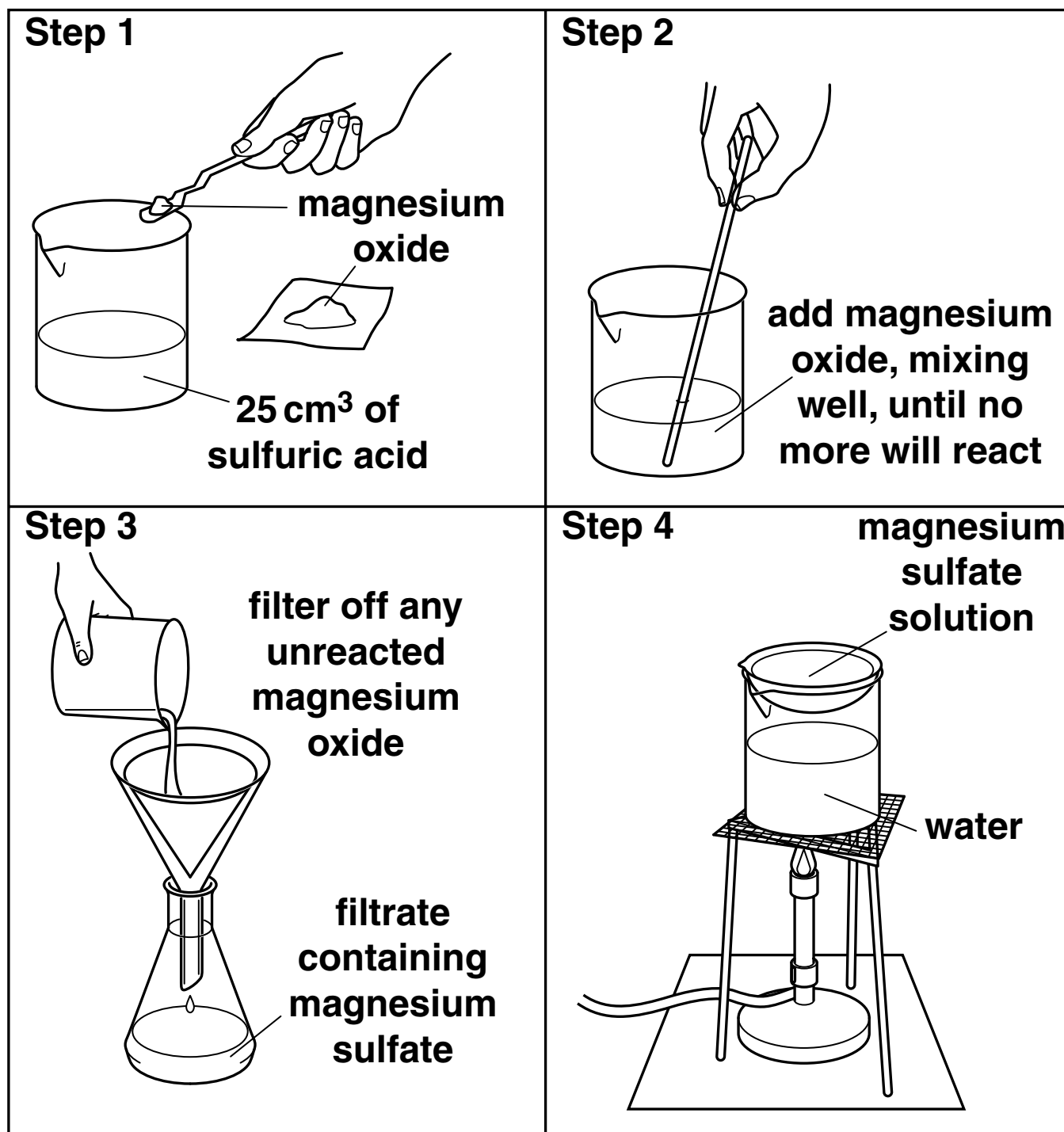
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atom economy = \_\_\_\_\_ % [2]

**(c) Look at the diagrams. They show the method Megan uses to make magnesium sulfate.**



**Megan predicts that she will make 6.0 g of magnesium sulfate.**

**She actually makes 4.2 g.**



**Suggest possible reasons why Megan's percentage yield is less than 100%.**

**Use the diagrams to help you.**



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

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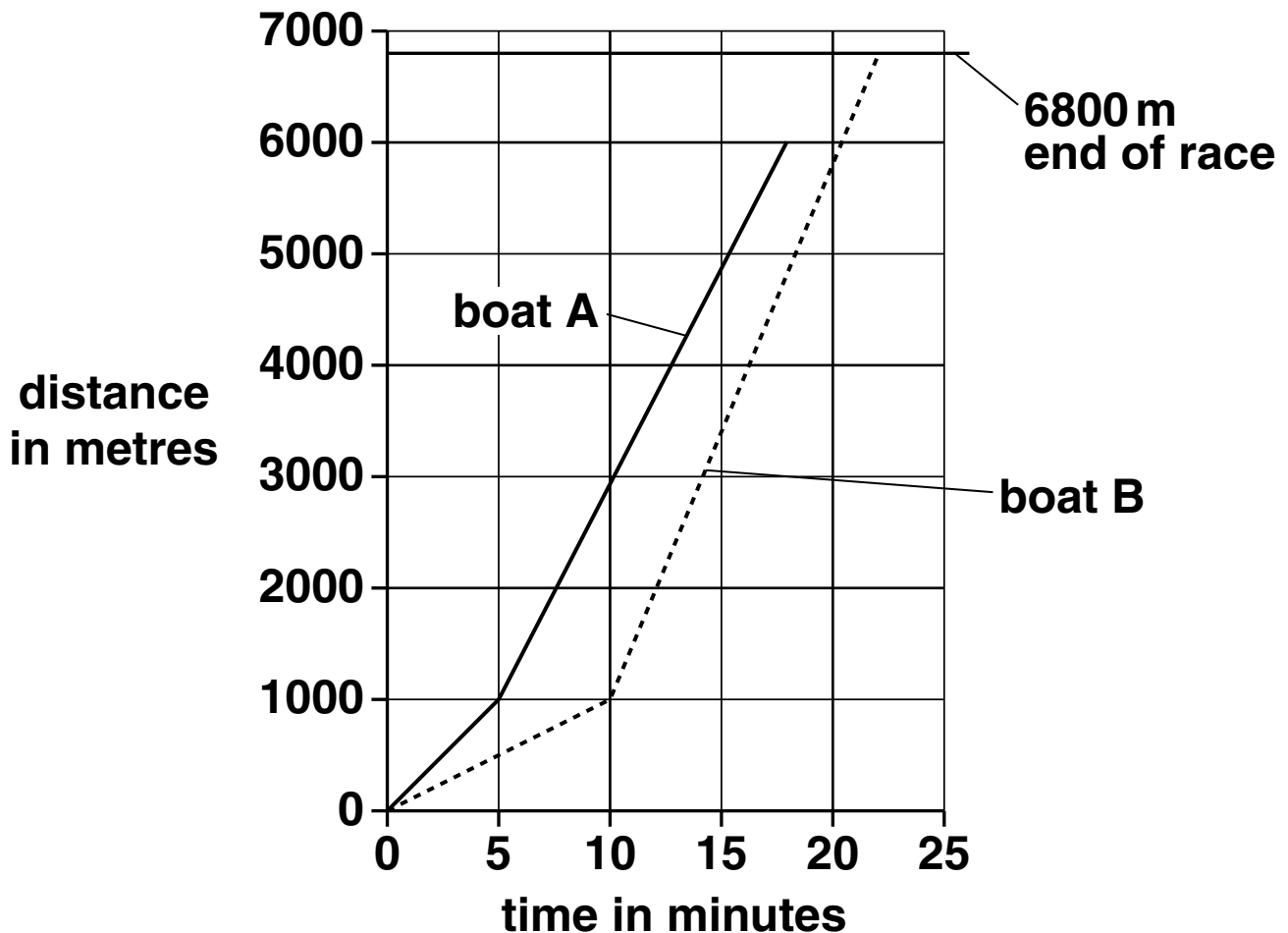
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[6]

## SECTION C – Module P3

9 Two boats race over a distance of 6800 m.

Here is the distance–time graph for part of the race.



After 10 minutes boat A and boat B travel at constant speed for the rest of the race.

**(a) Draw on the graph to extend the graph line for boat A to 6800 m.**

**Which boat won the race?**

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**Explain your answer.**

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**[2]**

- (b) Boat B completes the 6800 m race in 22 minutes and has an average speed of 309 metres per minute. Calculate the average speed of boat A for the 6800 m race.  
Compare the differences in speed between boat A and boat B over the whole race.



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

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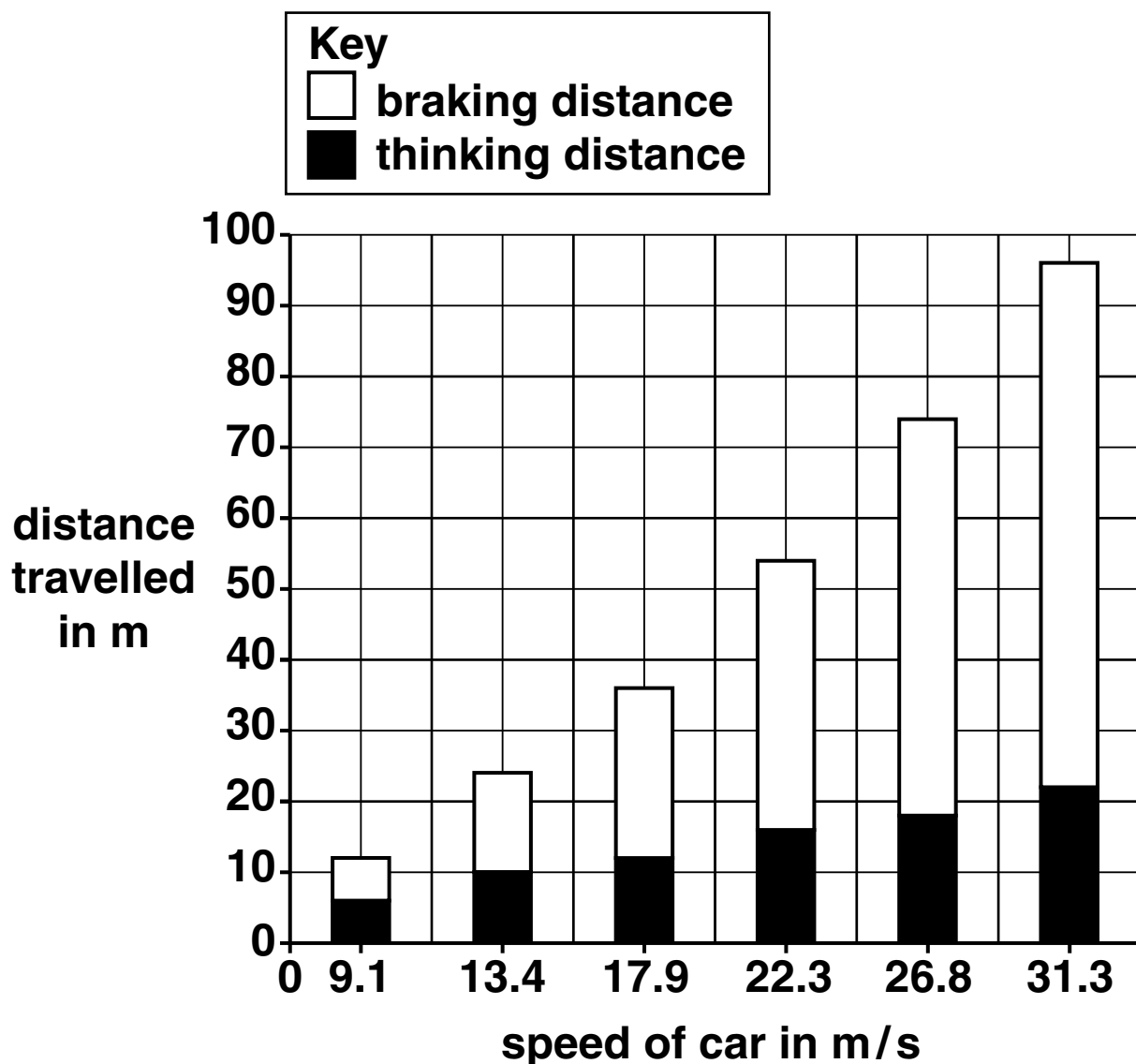
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[6]

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**10 Here is some scientific evidence about drivers stopping cars safely.**



**(a) Look at the claim.**

**‘As the speed of the car increases both the braking distance and the thinking distance increase.’**

**Is this claim supported by the scientific evidence?**

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**Explain your answer USING DATA from the graph.**

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[2]

**(b) The following factors were kept constant when the evidence was collected.**

**amount of alcohol in driver's blood**

**driver tiredness**

**driver distractions**

**condition of the tyres**

**One of these factors is kept constant because it will change the braking distance of the car.**

**(i) Which factor affects BRAKING distance?**

**Choose from the list.**

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[1]

**(ii) Increasing speed increases braking distance.**

**Write down another factor that INCREASES braking distance and explain why.**

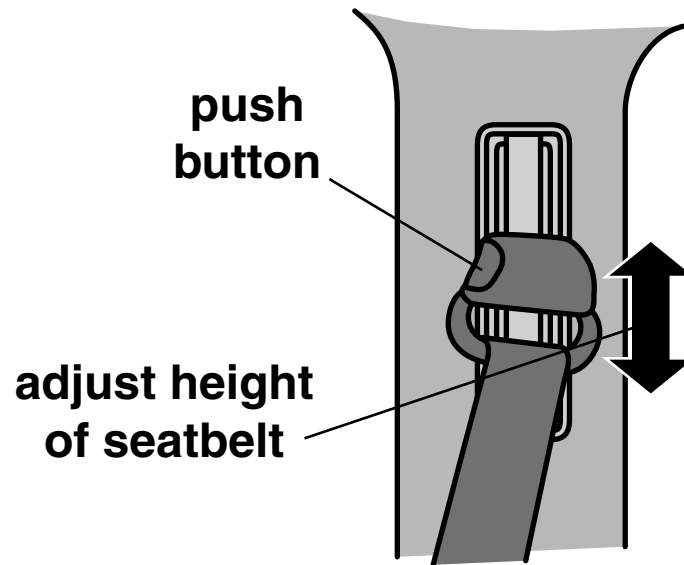
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[2]

**(c) Car manufacturers add safety features to their cars.**

**One of these safety features is adjustable seatbelts.**



**Describe the risks and benefits of using adjustable seatbelts.**

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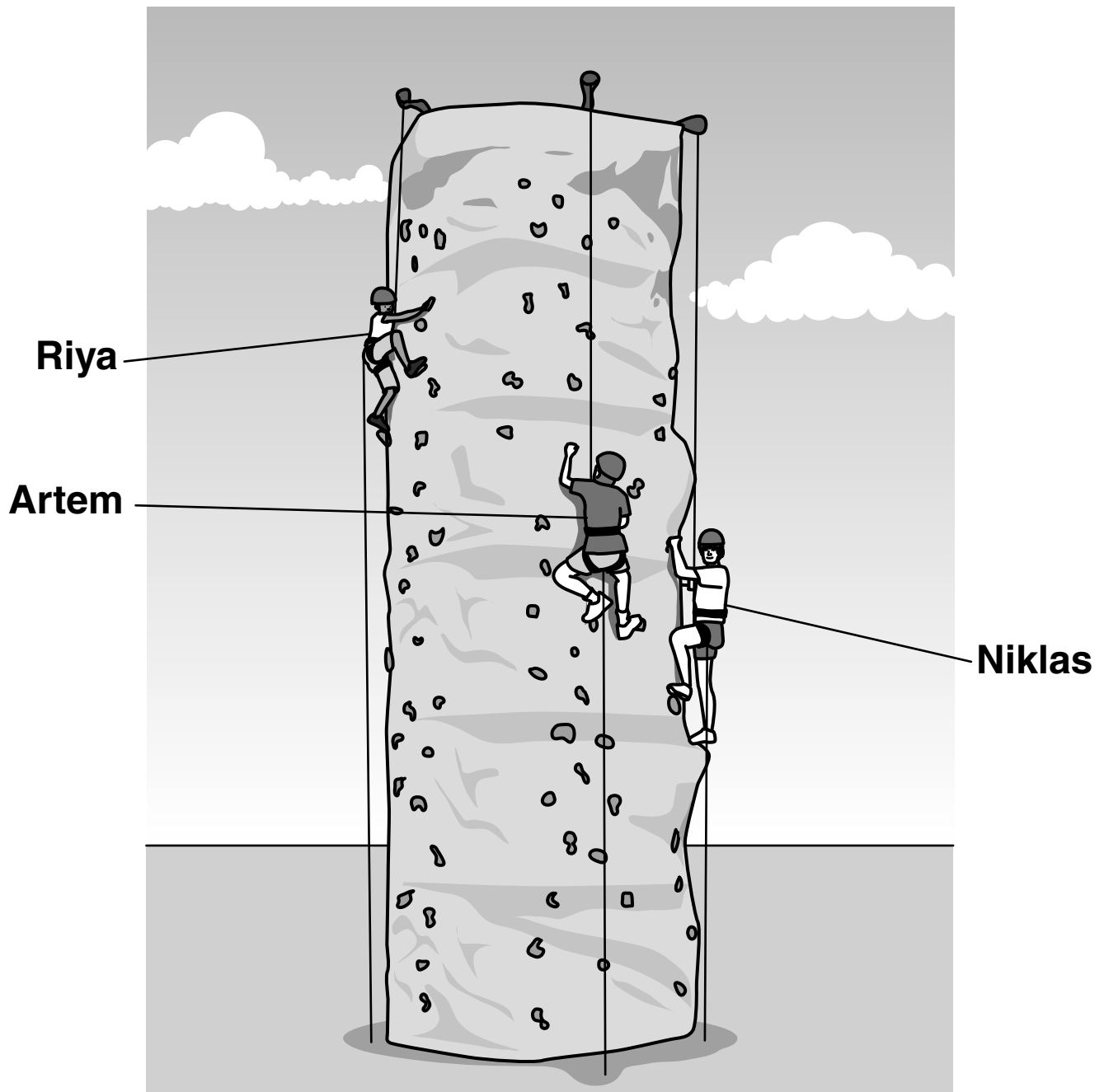
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**[3]**



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## 11 Riya, Artem and Niklas climb a rock wall.



Here is information about their climb.

NAME	WEIGHT IN N	HEIGHT OF CLIMB IN m	TIME TO CLIMB IN s
Riya	300	7.0	120
Artem	350	5.0	180
Niklas	700	4.0	100

(a) Calculate the work done by Riya.

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Work done = \_\_\_\_\_ joules [2]

(b) Niklas only climbs 4.0 m but he thinks he has done more work than Riya.

He is correct.

Explain why.

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 [1]

- (c) Artem calculates the power developed during his climb.**

$$\frac{350 \times 5.0}{180} = 9.72$$

- (i) Complete the sentence to give the unit of power.**

**Artem's power is 9.72 \_\_\_\_\_ . [1]**

- (ii) Artem wants to increase his power but only wants to climb up 5.0 m.**

**Describe how he can increase his power.**

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

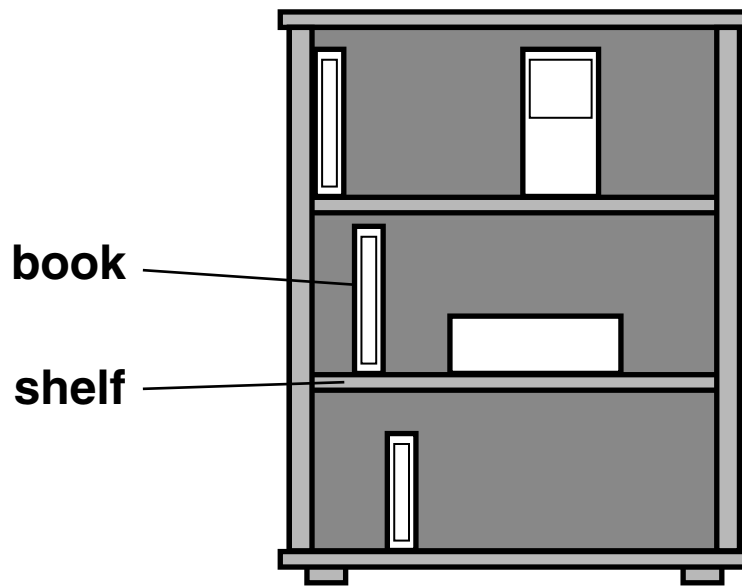
**12 This question is about gravitational potential energy (GPE) and kinetic energy (KE).**

**(a) Put ticks (✓) in the table to show what GPE and KE depend on.**

	<b>GPE</b>	<b>KE</b>
<b>mass</b>		
<b>position in Earth's gravitational field</b>		
<b>speed</b>		

**[2]**

- (b) There are five books in a bookcase with three shelves.



All the books are made of the same material.

Put an X on the BOOK with the most GPE.

Explain why you have chosen this book.

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[2]

**END OF QUESTION PAPER**

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