OCR
Oxford Cambridge and RSA

F

Tuesday 9 June 2015 – Afternoon

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B721/01 Additional Science modules B3, C3, P3 (Foundation Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

* B 7 2 1 0 1 *

* 4 4 1 7 7 6 2 9 4 3 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- 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**.
- This document consists of **28** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × 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

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

power = force × speed

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

momentum = mass × velocity

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

GPE = mgh

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

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

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.

Student	Pulse rate in beats per minute				
	1 min of exercise	2 min of exercise	3 min of exercise	4 min of exercise	5 min of exercise
1	88	98	102	110	110
2	92	96	103	115	118
3	87	100	112	112	130
4	93	109	115	120	125
5	90	93	101	112	112
Mean	90	99	107	114	

(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.

.....

.....

..... **[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?

.....

.....

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

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

Finish the symbol equation for aerobic respiration.

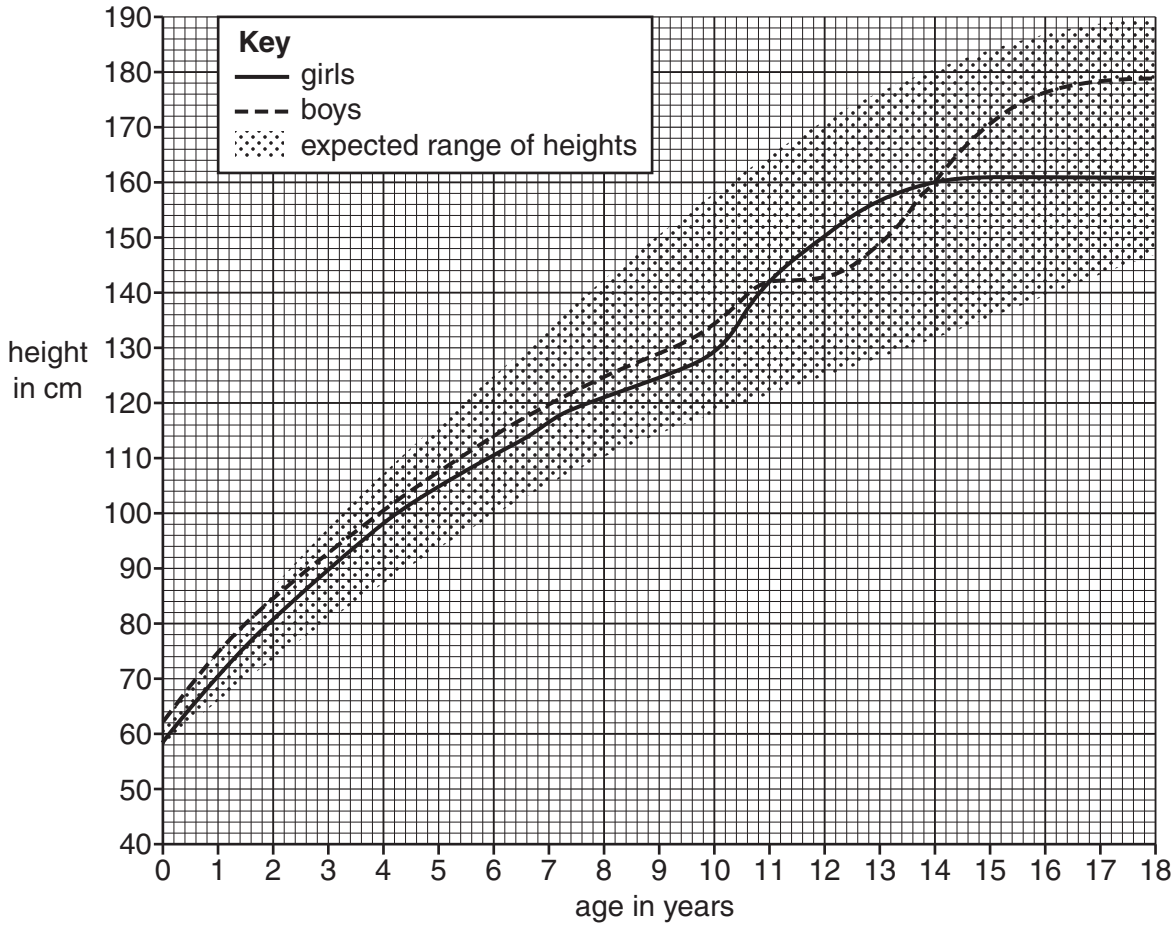
$C_6H_{12}O_6 + 6O_2 \rightarrow$ ..... $+ 6H_2O$ **[1]**

(ii) Why is blood important for aerobic respiration?

..... **[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.

.....

.....

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

3 Look at the picture of a firefly.

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

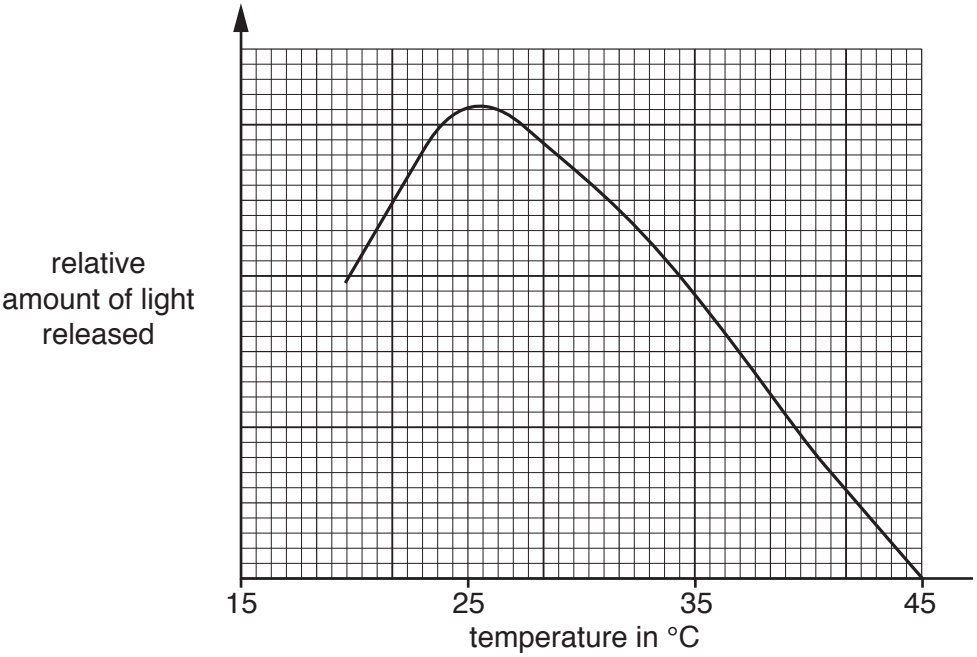
Just after dark is the best time to see fireflies flashing light.

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.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[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.

.....

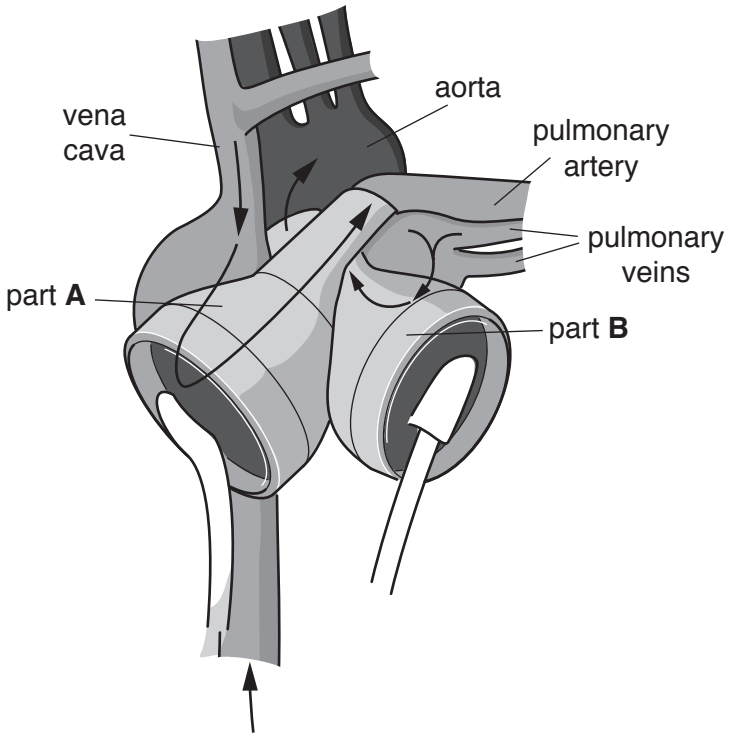
.....

.....

..... **[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.

.....

..... **[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.

.....

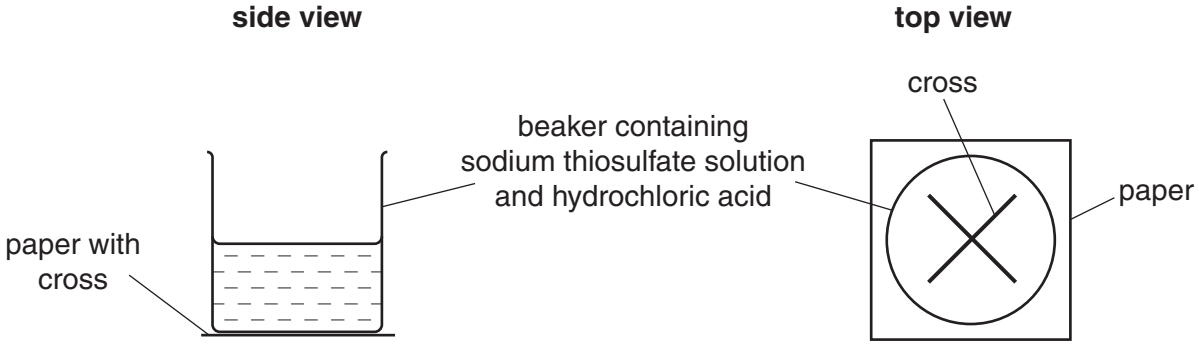
.....

..... **[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.

Concentration	Reaction time in seconds
A	43
B	72
C	124
D	61

(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.

.....

.....

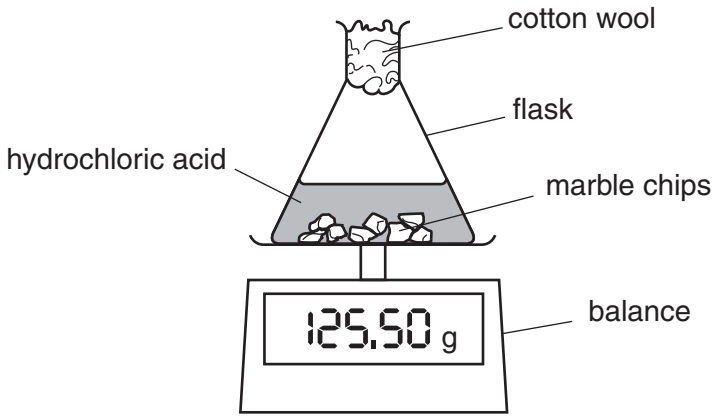
..... **[2]**

(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.

Time in minutes	Loss in mass in g	
	Large marble chips	Small marble chips
0	0	0
4	0.4	0.8
8	0.8	1.4
12	1.2	1.6
16	1.5	1.7
20	1.7	1.7

(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.

.....

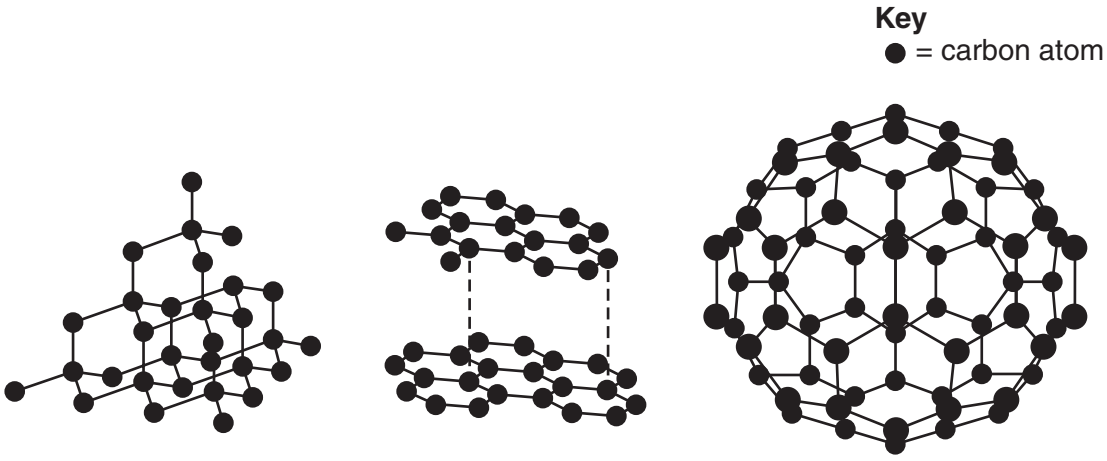
.....

.....

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

6 This question is about different forms of carbon.

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

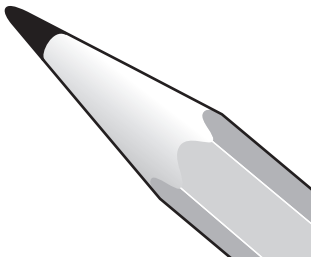


X **graphite** **Buckminster fullerene**

(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]**

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^3 of water.

Look at his table of results.

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

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

.....

.....

.....

.....

.....

.....

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

(b) Look at David's results.

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

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]**

8 Megan is making some magnesium sulfate.

Look at the equations.

$$\text{sulfuric acid} + \text{magnesium oxide} \rightarrow \text{magnesium sulfate} + \text{water}$$

$$H_2SO_4 + MgO \rightarrow MgSO_4 + H_2O$$

(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	H_2SO_4	98
magnesium oxide	MgO	40
magnesium sulfate	$MgSO_4$	120
water	H_2O	18

Calculate the **atom economy** of this reaction.

Water is a waste product.

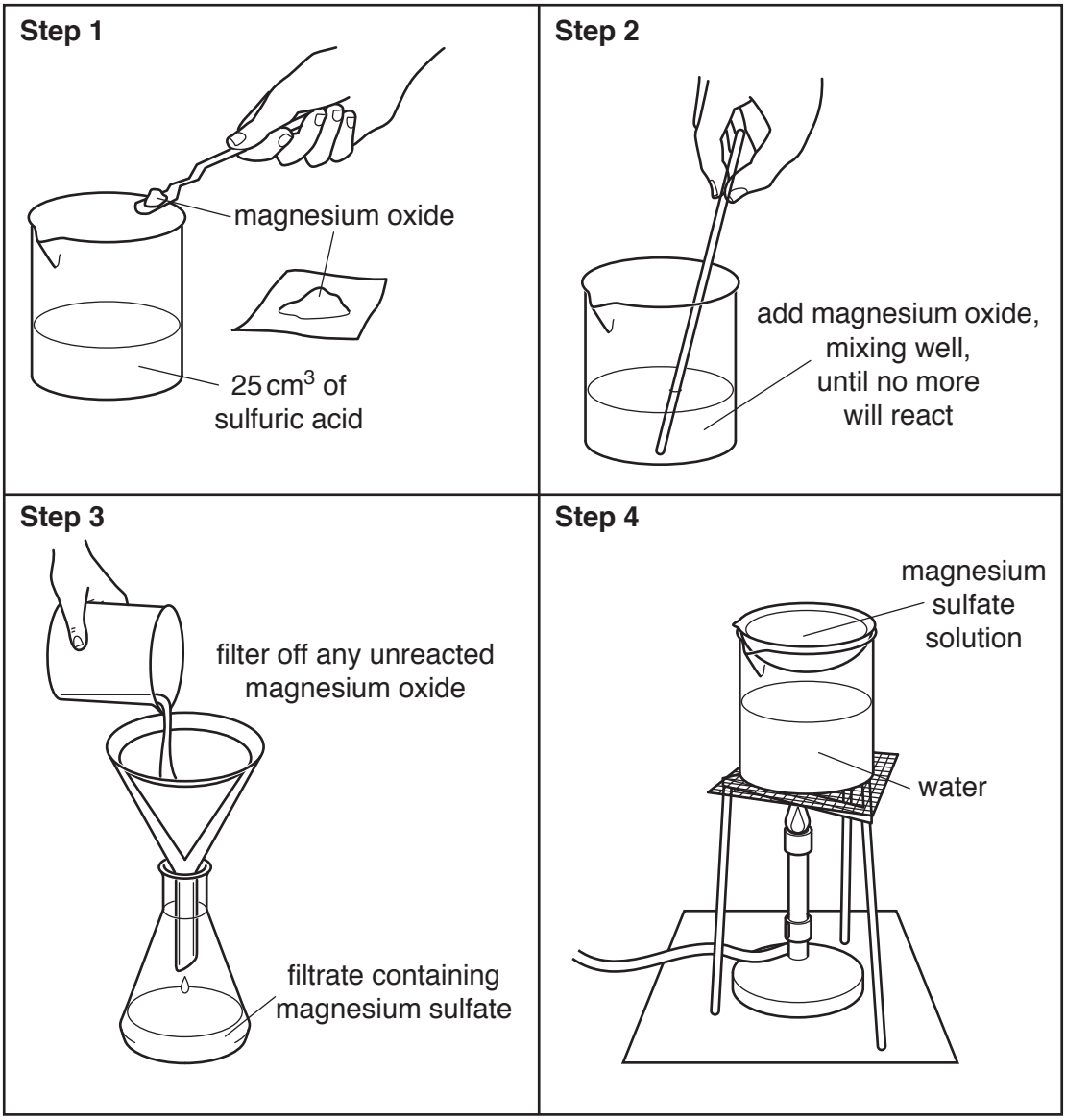
.....

.....

.....

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.

Calculate her **percentage yield** of magnesium sulfate.

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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

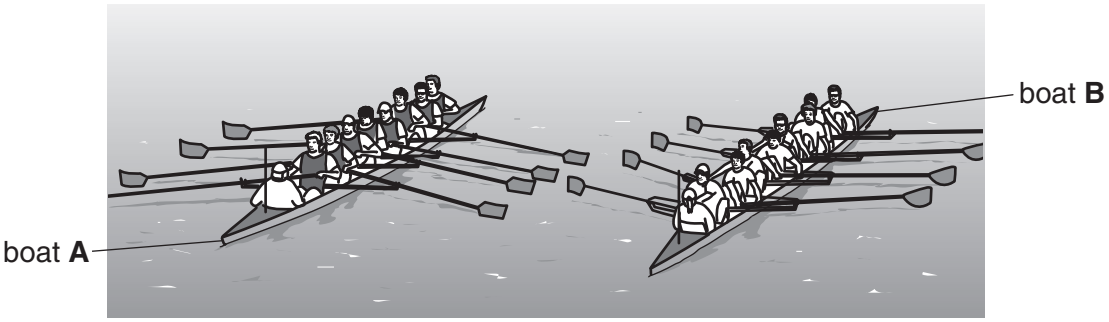
.....

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

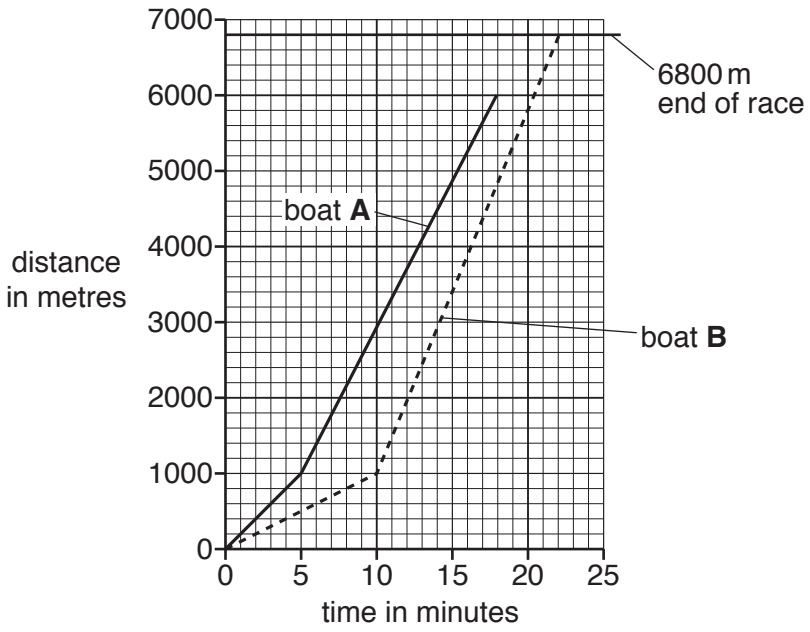
SECTION C – Module P3

9 Two boats race over a distance of 6800 m.

The picture shows the boats at the start of the race.



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?

.....

Explain your answer.

.....

..... **[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.

.....

.....

.....

.....

.....

.....

.....

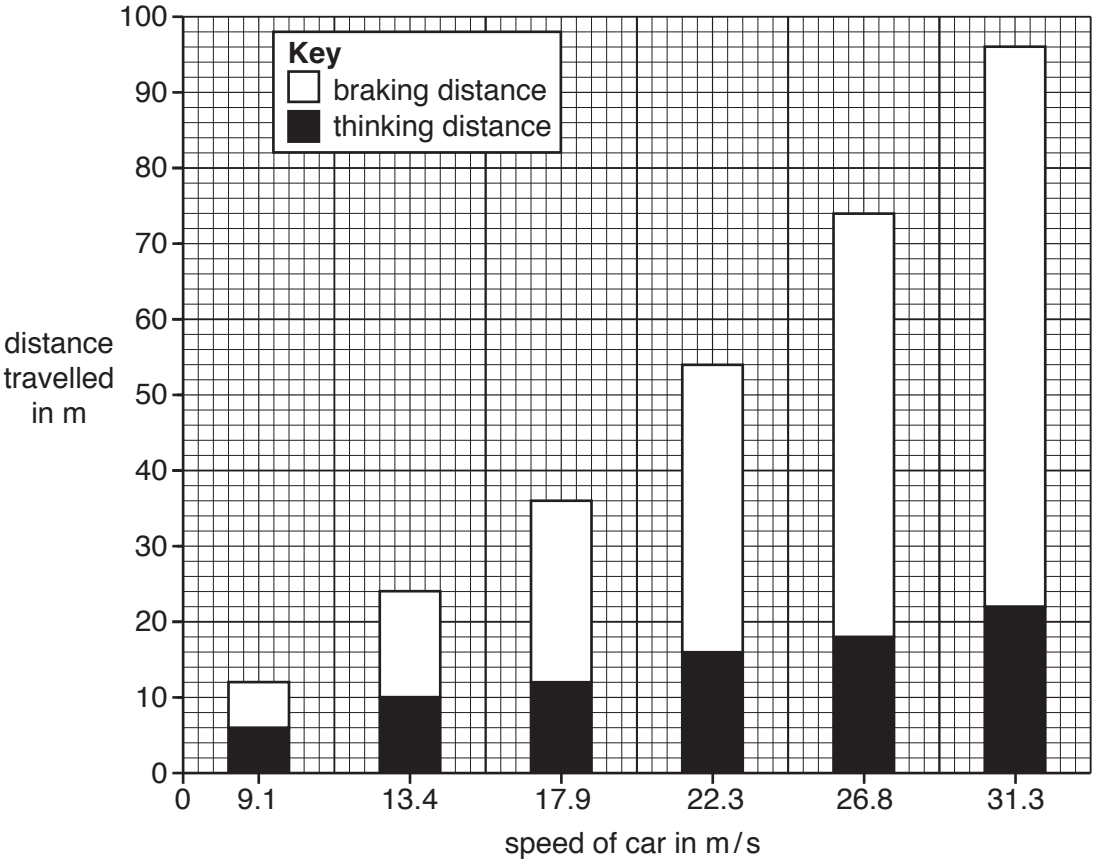
.....

.....

.....

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

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?

.....

Explain your answer **using data** from the graph.

.....

.....

..... **[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.

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

(ii) Increasing speed increases braking distance.

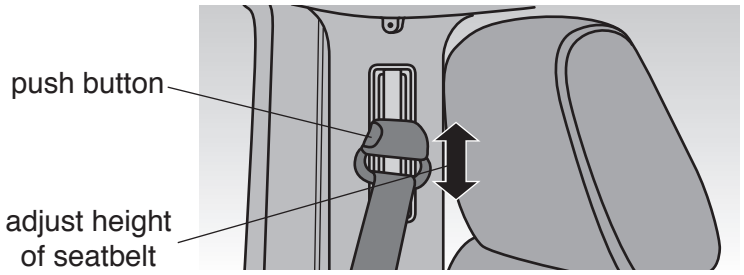
Write down another factor that **increases** braking distance and explain why.

.....

..... **[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.

.....

.....

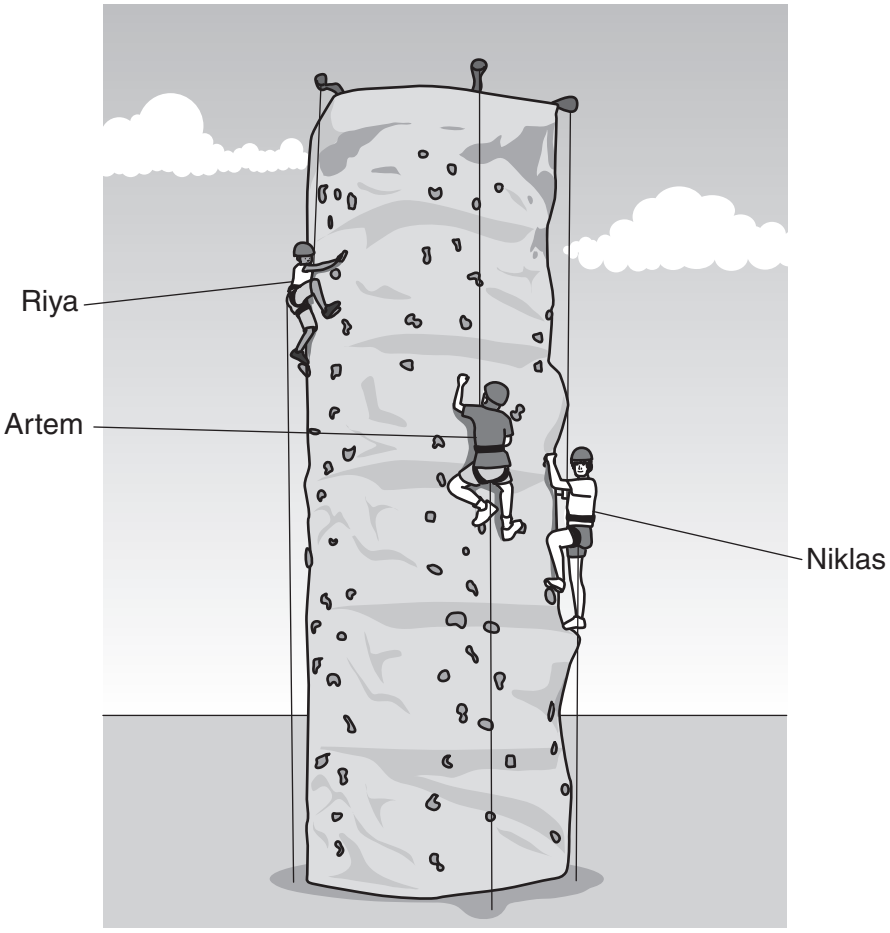
.....

.....

.....

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

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.

.....

.....

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.

.....

..... **[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]**

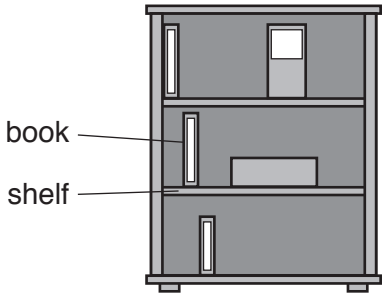
12 This question is about gravitational potential energy (GPE) and kinetic energy (KE).

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

	GPE	**KE**
mass		
position in Earth's gravitational field		
speed		

[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.

.....

.....

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

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.