

THIS IS A NEW SPECIFICATION

**H****Tuesday 22 January 2013 – Morning****GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B****B721/02** Additional Science modules B3, C3, P3 (Higher 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

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

- Your 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.

2

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

3

BLANK PAGE

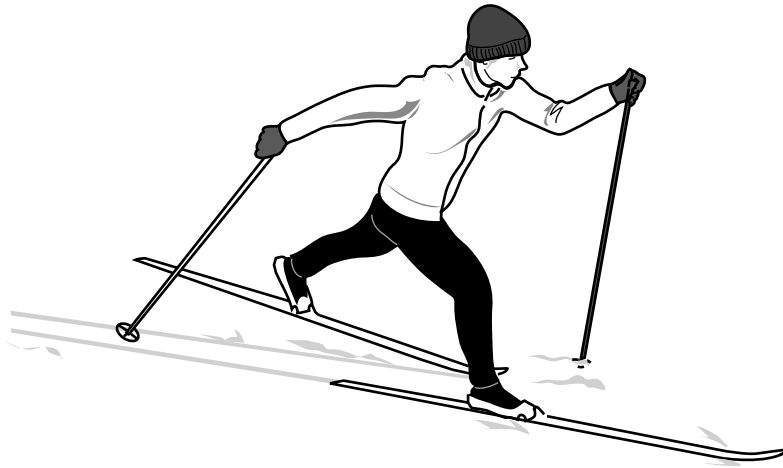
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

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.

.....
 **[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 **VO₂ Max**.

The table shows typical ranges of VO₂ Max for different men.

	Range of VO ₂ Max
non-sportsman	43–52
cross-country skier	65–94
runner	60–85
weightlifter	43–52

5

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

Their muscles respire anaerobically.

Explain why their VO_2 Max is the same as a non-sportsman.

..... [1]

- (ii) It is hard to measure VO_2 Max.

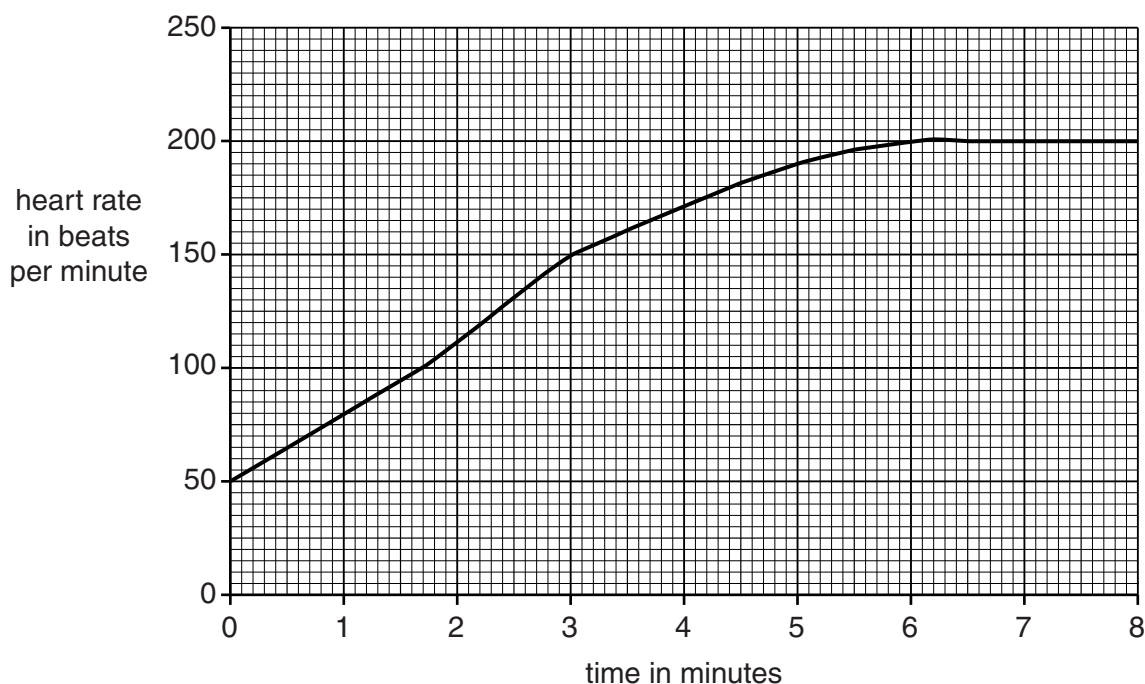
It can be estimated using the formula below.

$$VO_2 \text{ Max} = \frac{15 \times \text{maximum heart rate}}{\text{resting heart rate}}$$

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.



Work out Toby's 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]

- Turn over**

3 Haemoglobin is found in blood.

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

.....

.....

.....

..... [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.

.....

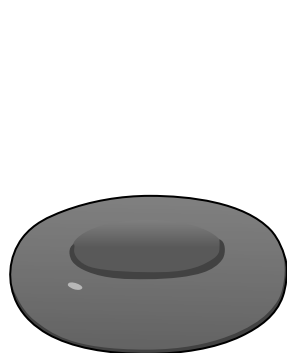
.....

..... [2]

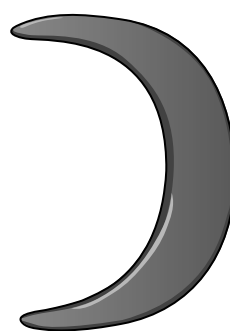
(c) Haemoglobin is found in red blood cells.

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.

.....

.....

..... [2]

[Total: 7]

BLANK PAGE

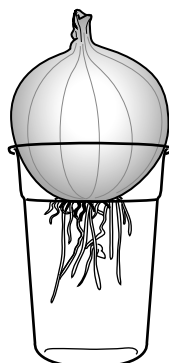
Question 4 begins on page 10

PLEASE DO NOT WRITE ON THIS PAGE

- 4 Noel investigates the growth of onions.

He puts an onion bulb in a jar of water.

The bulb starts to grow roots.



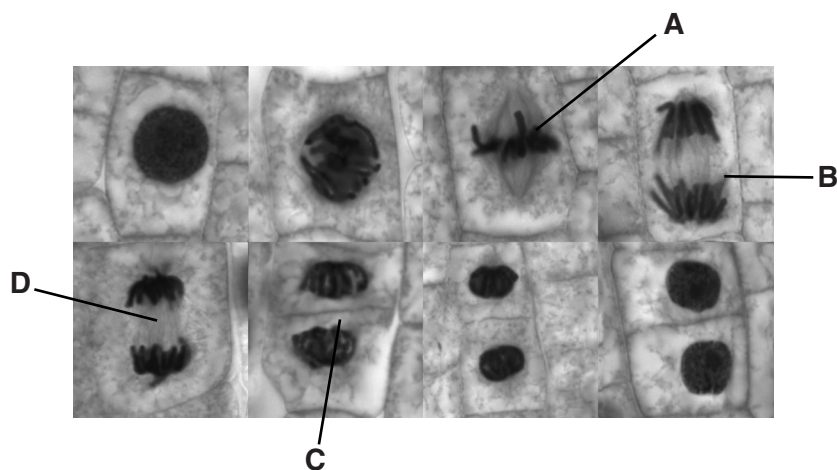
- (a) Cell division is happening in the tips of the roots to make new cells for growth.

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	
--	--	----------	--

[2]

11

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

What is the most likely reason for this?

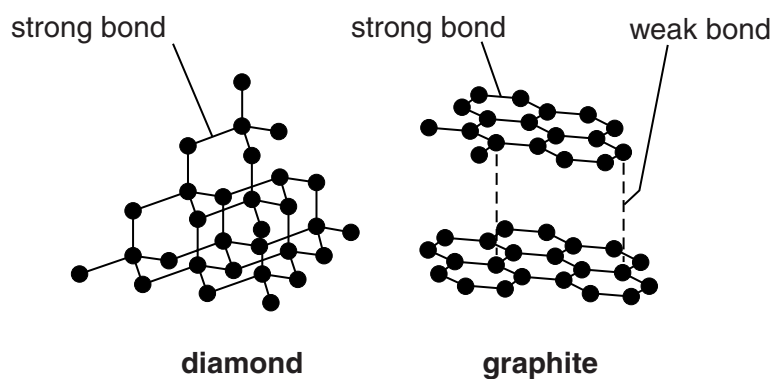
..... [1]

[Total: 4]

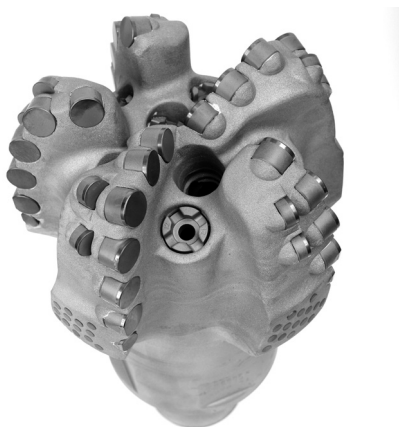
Question 5 begins on page 12

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.

.....
 [2]

- (b) Graphite is slippery.

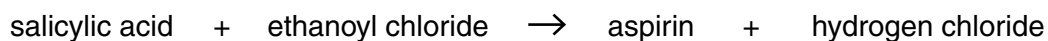
Explain why.

.....
 [1]

[Total: 3]

- 6 Aspirin is a medicine used to control pain.

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



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

Compound	Formula	Relative formula mass
salicylic acid	$\text{C}_7\text{H}_6\text{O}_3$	138
ethanoyl chloride	$\text{C}_2\text{H}_3\text{OCl}$	78.5
aspirin	$\text{C}_9\text{H}_8\text{O}_4$	180
hydrogen chloride	HCl	36.5

- (a) Calculate the **atom economy** of this reaction.

.....

answer = % [2]

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

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

Explain why.

.....

 [2]

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

Explain why.

.....

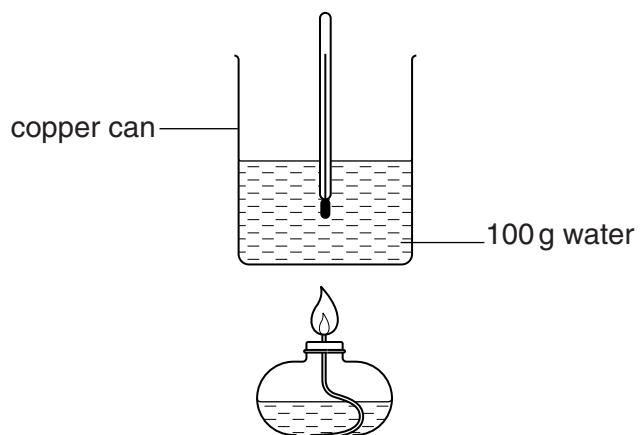
 [2]

[Total: 6]

14

- 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.

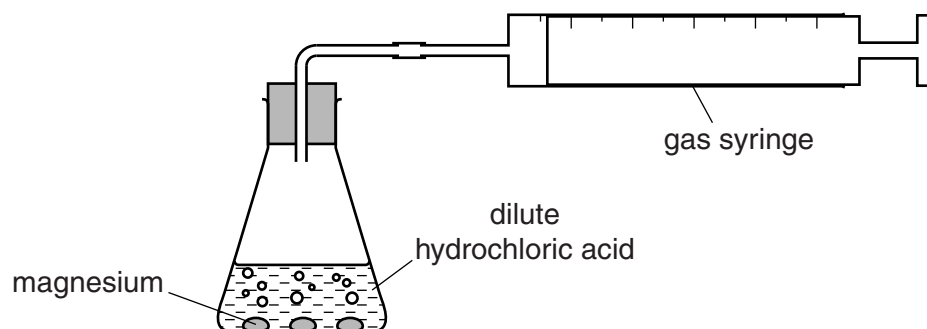
Fuel	Temperature at start in °C	Temperature at end in °C	Mass of fuel burned in g	Energy transferred per gram in J
A	20	30	0.5	8400
B	18	43	0.8	
C	22	42	0.4	

- 8 Jan and Mike investigate the reaction between magnesium lumps and hydrochloric acid, HCl .
Magnesium chloride solution, MgCl_2 , and hydrogen gas, H_2 , are made.

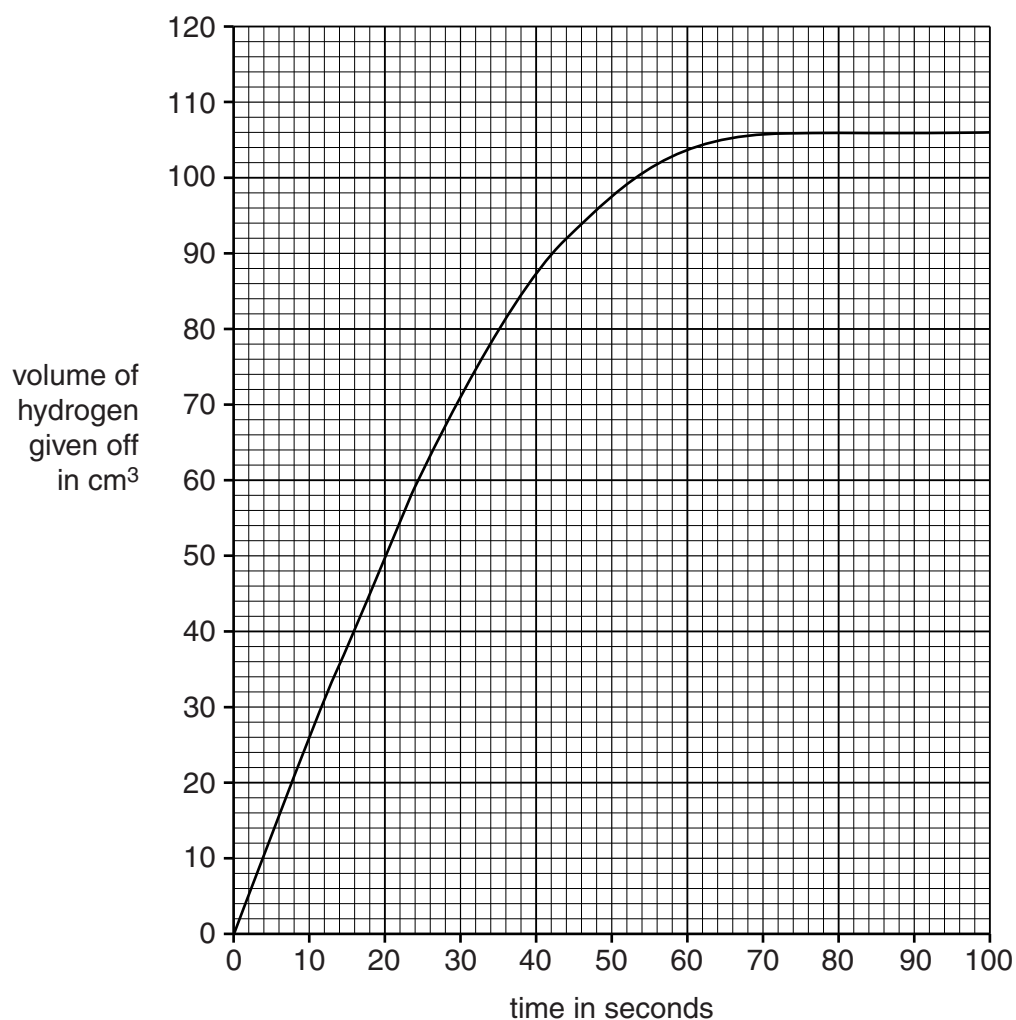
(a) Write a **balanced symbol** equation for this reaction.

..... [2]

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



Look at the graph of their results



17

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

..... cm³ [1]

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

.....
.....
.....

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.

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

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

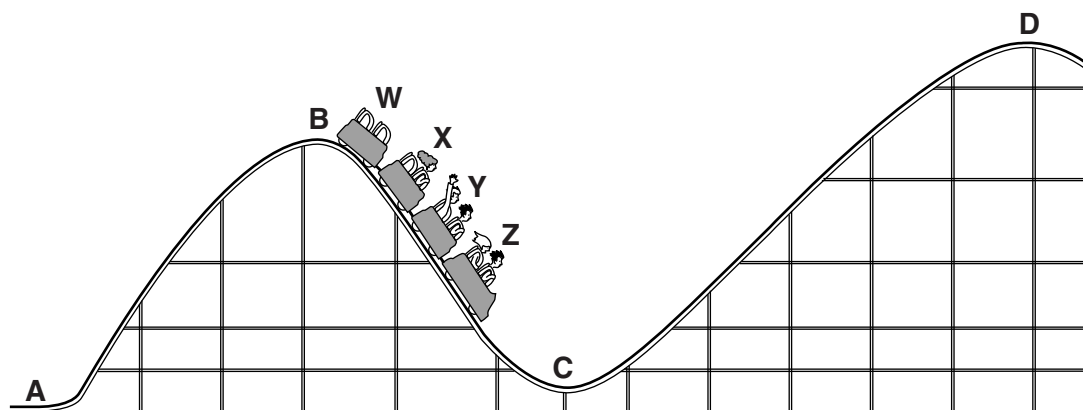
Use the reacting particle model to explain why.

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

[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?

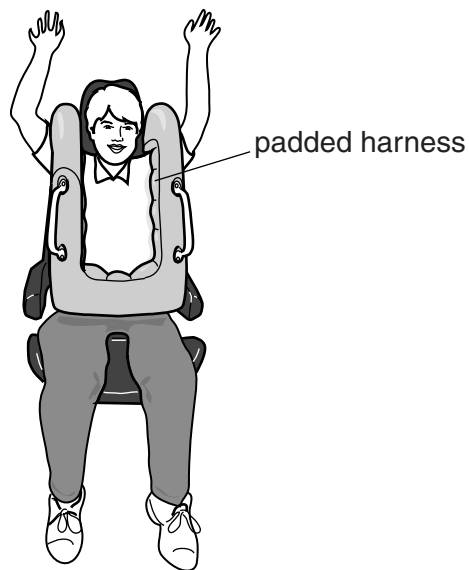
.....

Explain your answer.

.....
 [1]

19

- (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.

.....

.....

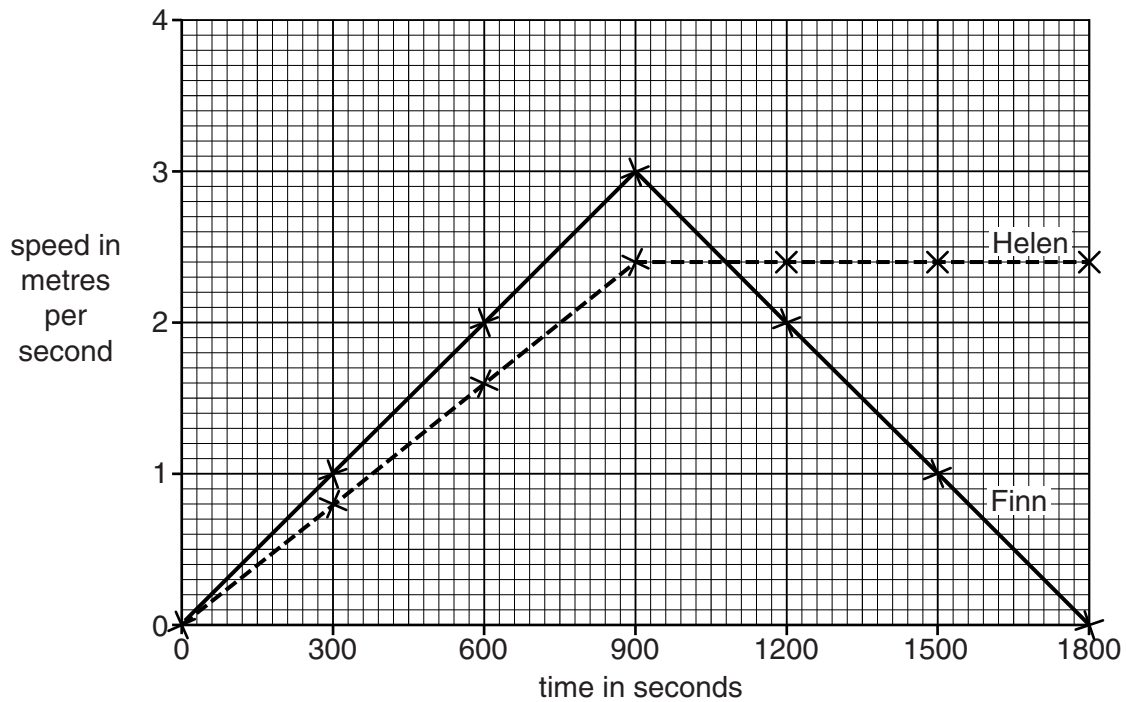
..... [2]

[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.

[6]

[Total: 6]

21

BLANK PAGE

Question 11 begins on page 22

PLEASE DO NOT WRITE ON THIS PAGE

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

..... [4]

23

- (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.

.....

.....

.....

.....

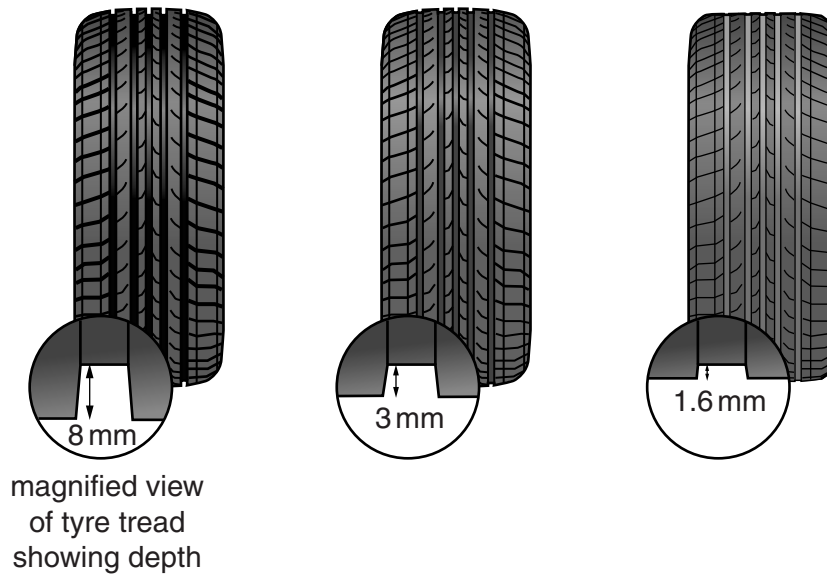
..... [3]

[Total: 7]

Question 12 begins on page 24

12 Car tyres have tread.

As tyres become worn the amount of tyre tread decreases.



(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]

25

(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.

.....

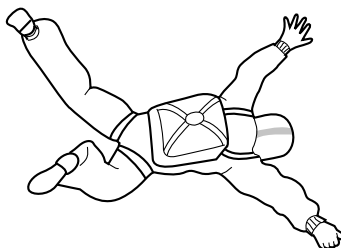
.....

..... [2]

[Total: 5]

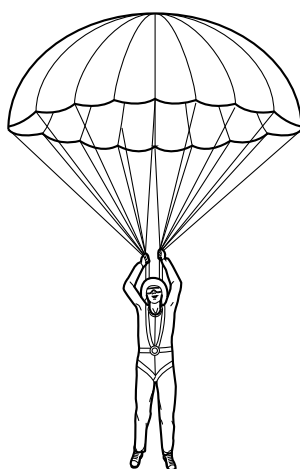
13 David is a parachutist.

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.

.....

.....

.....

..... [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.

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

[Total: 3]

END OF QUESTION PAPER



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

The Periodic Table of the Elements

1	2	Key						3	4	5	6	7	0					
		relative atomic mass atomic symbol name atomic (proton) number																
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							