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F

Tuesday 22 January 2013 – Morning

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

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

1521611007

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

MODIFIED LANGUAGE

B721 01

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.

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

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

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

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Question 1 begins on page 4

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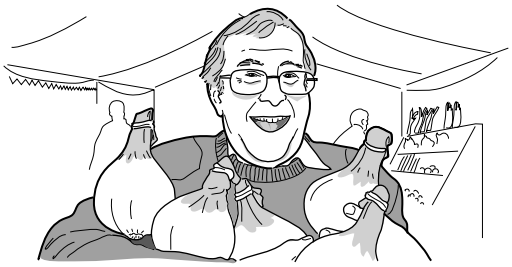
Answer **all** the questions.

SECTION A – Module B3

1 Noel grows giant onions.

He wants to grow onions to enter into a competition.

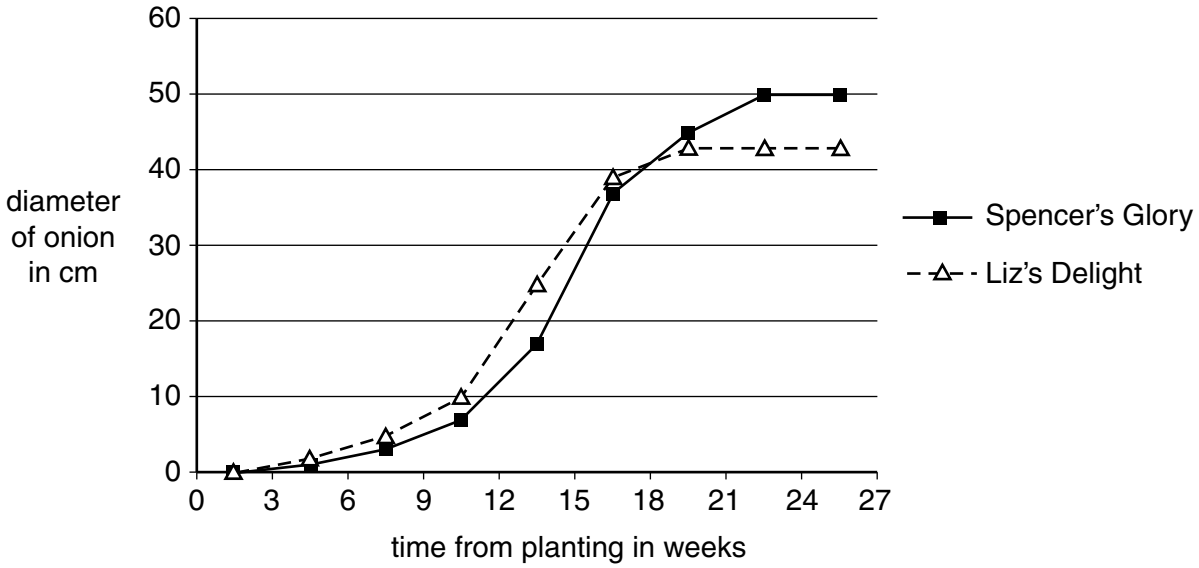


(a) Noel is growing two types of onion, Spencer's Glory and Liz's Delight.

Noel plants the onions.

He measures the growth of the onions at regular intervals.

His results are shown on the graph.



(i) What did Noel measure to show the growth of the onions?

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

(ii) Noel chooses Spencer's Glory to take to the vegetable show.

Suggest why he chooses this onion.

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

(b) Noel wants to see which onion has the largest cells.

Explain how he could make a microscope slide of onion tissue (so that he can see the cells).

.....

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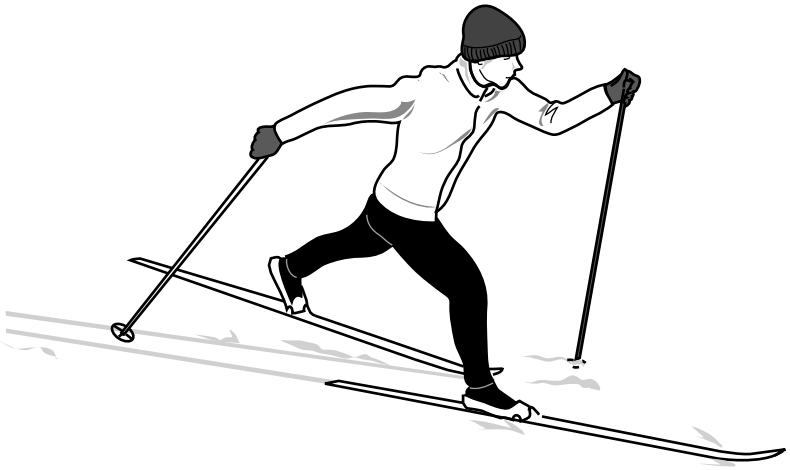
..... **[2]**

[Total: 4]

Question 2 begins on page 6

2 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.

Why are mitochondria needed in muscle cells?

.....

..... **[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 **VO_2 Max**.

The table shows typical ranges of VO_2 Max for different men.

	Range of VO_2 Max
non-sportsman	43–52
runner	60–85
cross-country skier	65–94

(i) What relationship is there between fitness and VO_2 Max?

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

(ii) It is hard to measure VO_2 Max.

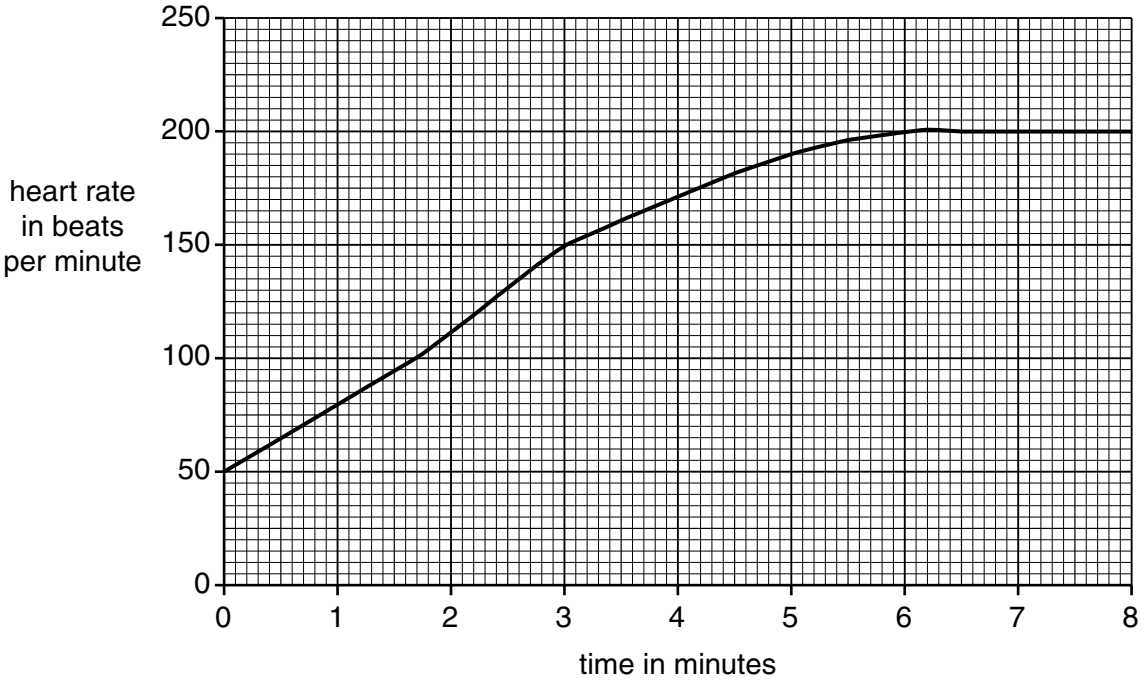
It can be estimated using the formula below.

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

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, using evidence from the table and the graph.

.....

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

Turn over for the remainder of question 2

(c) Read the article.

Heart fear for cross-country skiers

Cross-country skiers have hearts that are bigger than average. This helps the skiers to 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 these skiers had fibrillation.

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

However, the skiers developed the condition at a younger age than most men.

(i) Suggest how having a bigger heart helps cross-country skiers to compete.

.....

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

(ii) Fibrillation causes blood to collect in the top chambers of the heart.

The platelets then cause changes in the blood.

Suggest why this is harmful.

.....

.....

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

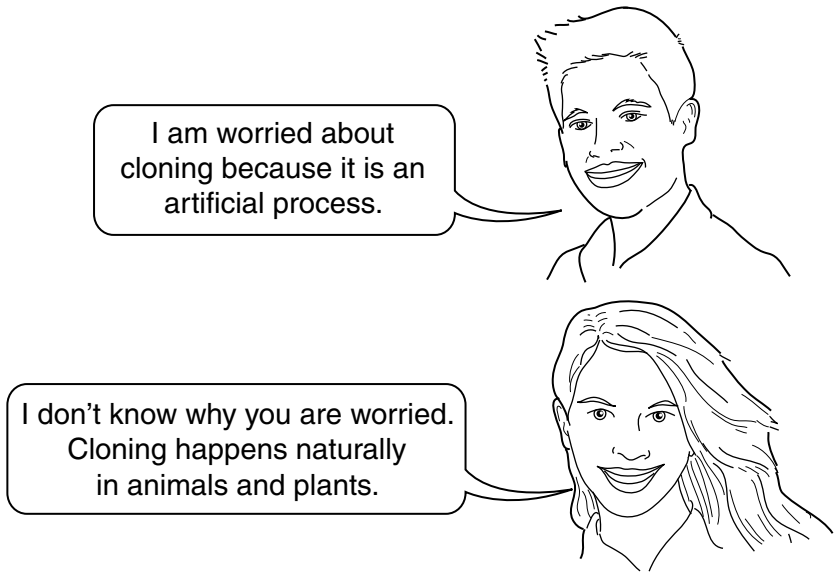
(iii) Explain how the results of the study could be used to show that there is **no** link between skiing and fibrillation.

.....

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

[Total: 11]

3 Two students are discussing cloning.



Write about how cloning can happen naturally and artificially in plants and animals.

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

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

[Total: 6]

4 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 change in the gene that codes for haemoglobin.

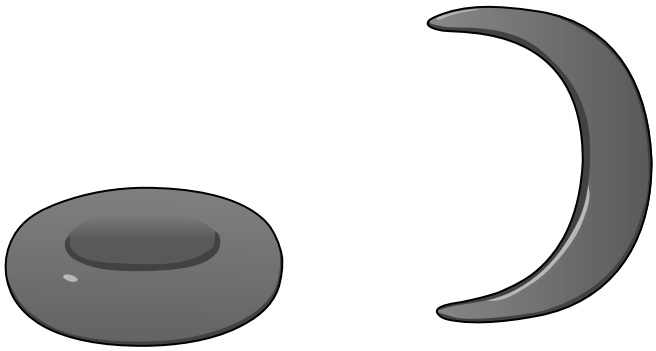
(a) Write down the name for a change in the structure of a gene.

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

(b) 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

(i) Why does the blood flowing through Cyril's muscles become more acidic during exercise?

.....

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

(ii) Cyril's red blood cells do **not** work so well after they change shape.

Suggest **one** reason why.

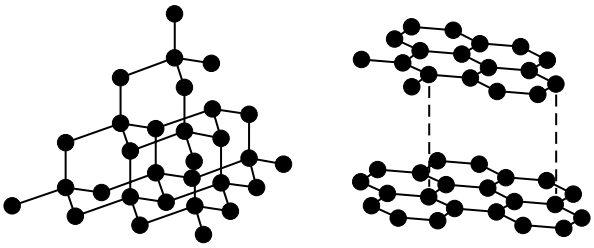
.....

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

[Total: 4]

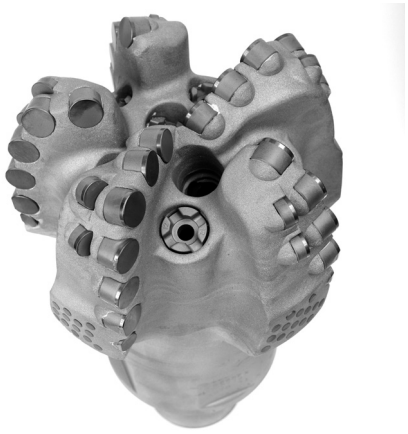
SECTION B – Module C3

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



diamond **graphite**

(a) Diamond is used in tools made for cutting.



Explain why.

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

(b) Graphite does not dissolve in water.

Write down **two other** properties of graphite.

.....

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

[Total: 3]

6 Ammonia is an industrial chemical made in large quantities.

It is made using a **continuous** process.

Many medicines are made using **batch** processes.

(a) Write about the differences between a continuous process and a batch process.

.....

.....

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

(b) 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

$C_7H_6O_3$ + C_2H_3OCl → $C_9H_8O_4$ + HCl

(i) Put a (ring) around the **formula** of one **reactant**. **[1]**

(ii) Look at the table. It shows some information about the compounds used in making aspirin.

Compound	Formula	Relative formula mass
salicylic acid	$C_7H_6O_3$	138
ethanoyl chloride	C_2H_3OCl	78.5
aspirin	$C_9H_8O_4$	180
hydrogen chloride	HCl	

Complete the table to show the relative formula mass of hydrogen chloride.

The relative atomic mass of H is 1 and of Cl is 35.5. **[1]**

(iii) Calculate the **atom economy** of this reaction.

.....

.....

.....

answer = ... % **[2]**

(c) New medicines must be tested before they can be used.

Write down **one** reason why.

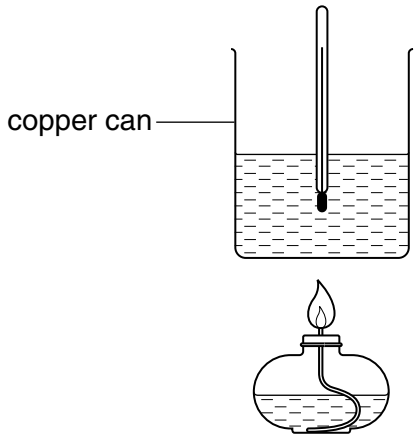
..... **[1]**

[Total: 7]

Question 7 begins on page 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 of 100 g of water at start in °C	Temperature of 100 g of water at end in °C	Mass of fuel burned in g
A	20	40	0.5
B	18	38	0.8
C	22	42	0.4

Write about how Nick and Lesley do the experiment, and explain which fuel gives out the most energy per gram.

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

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

[Total: 6]

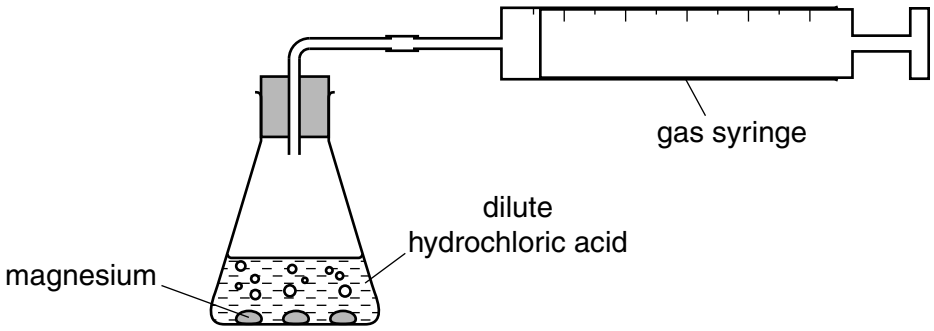
8 Jan and Mike investigate the reaction between magnesium lumps and hydrochloric acid.

Magnesium chloride solution and hydrogen gas are made.

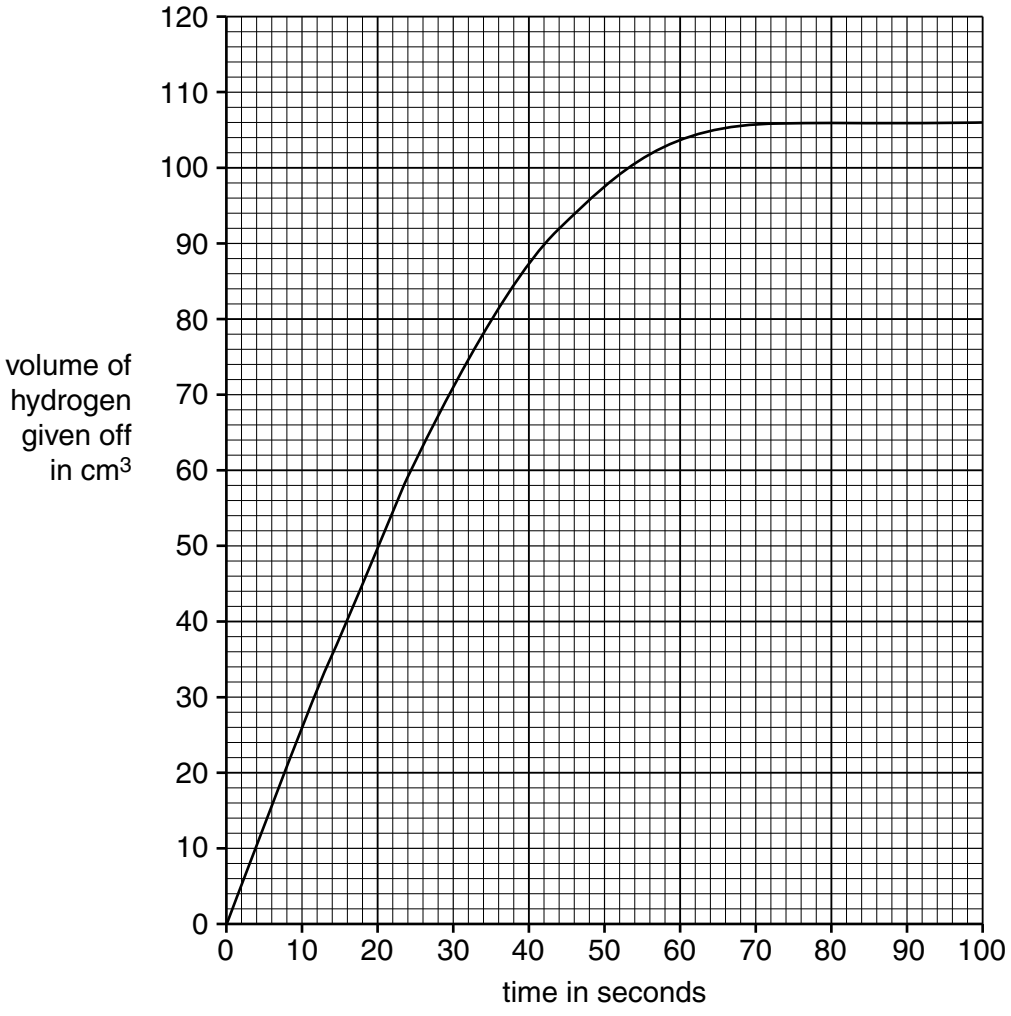
(a) Write a **word** equation for this reaction.

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

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



Look at the graph of their results



(i) How long does it take to make 50 cm^3 of hydrogen?

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

(ii) When the reaction has finished what volume of gas is made?

..... cm^3 **[1]**

(c) Explain why the reaction stops.

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

(d) Jan repeats the experiment with magnesium **powder** instead of magnesium **lumps**.

What happens to the rate of reaction?

Explain why.

.....

.....

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

(e) Jan and Mike want to speed up the reaction.

They do not want to change the mass of magnesium or the volume of the hydrochloric acid.

They know that using magnesium powder changes the speed of the reaction.

Write about **other** ways they could speed up the reaction.

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.....

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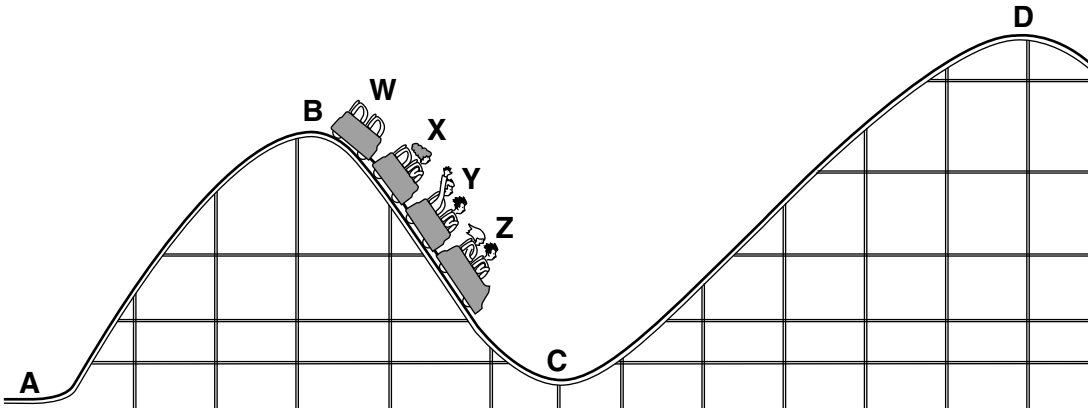
..... **[3]**

[Total: 9]

SECTION C – Module P3

9 Five people are on a roller coaster ride.

Part of the track is shown.



(a) In what position does a roller coaster car have the greatest **gravitational potential energy**?

Put a (ring) around the correct answer.

A **B** **C** **D** **[1]**

(b) The table shows the total mass of each roller coaster car.

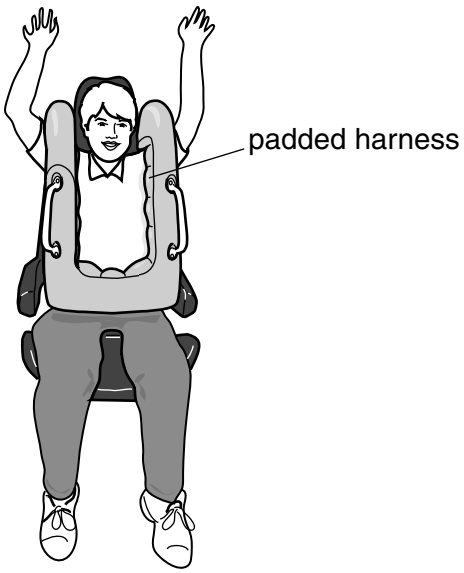
Car	Mass of car and passengers in kg
W	180
X	250
Y	310
Z	350

Which car has the greatest **momentum** as they move down the slope?

Put a (ring) around the correct answer.

W **X** **Y** **Z** **[1]**

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



(i) The cars stop quickly. This produces a rapid decrease in momentum.

What acts on the people as the cars stop?

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

(ii) The harness is padded. This protects the people.

Describe the benefit of wearing a padded harness when the cars stop quickly.

.....

.....

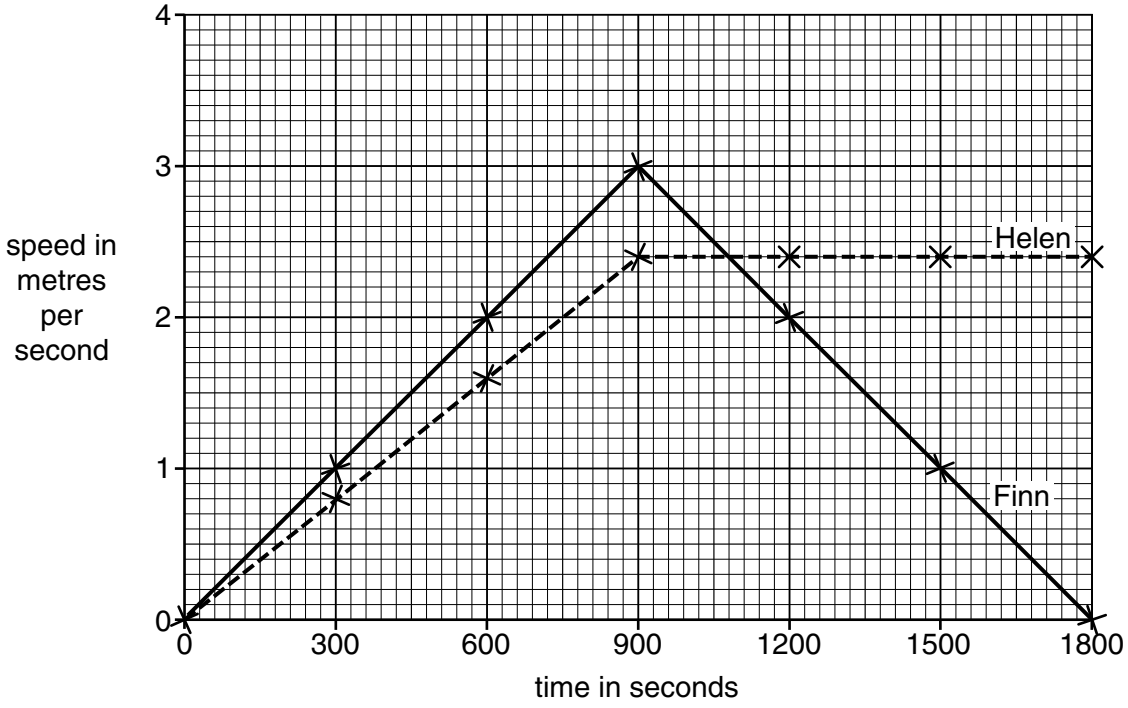
..... **[2]**

[Total: 5]

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 hybrid cars.

(a) Different hybrid cars have different **power** ratings.

What **unit** is used to measure power?

Put a (ring) around the correct answer.

joule **kilogram** **newton** **watt** **[1]**

(b) Some hybrid cars run on fuels made from fossil fuels.

Look at the table.

It shows how fuel consumption is affected by the size of the engine and the type of fossil fuel used.

Name of car	Fossil fuel	Size of engine	Fuel consumption in litres per 100 km
Acclaim	petrol	small	4.0
Balance	diesel	large	4.8
Citrus	petrol	medium	4.6
Dancer	diesel	medium	4.2
Eagle	LPG	medium	4.9
Robin	.....	.....	.....

These cars have the same shape and mass.

The Robin car is the **most efficient**.

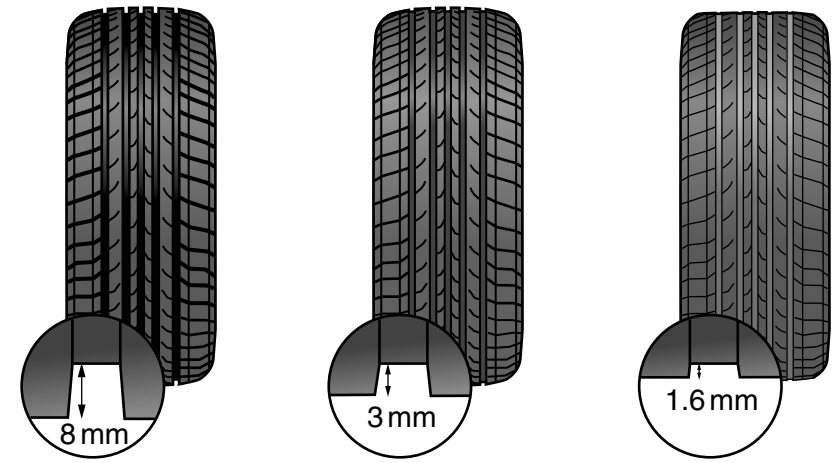
Using information from the table, suggest the type of fossil fuel and engine size of the Robin car, and estimate its fuel consumption.

Complete the table to show your answers. **[3]**

[Total: 4]

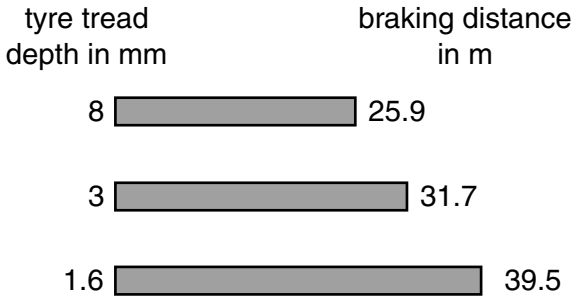
12 Car tyres have tread.

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.



(i) What is **braking distance**?

Complete the sentence.

Braking distance is the distance taken to stop once the .....

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

(ii) Describe the relationship between tyre tread depth and braking distance.

Explain why tyre tread depth is important for road safety.

.....

.....

..... **[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
2	warning to replace tyre
1.6	legal limit

A new type of tyre has been made.

The tread on the new tyre lasts ten times longer **but** when the tread depth reaches 4 mm, it quickly decreases to the legal limit.

Discuss the **advantages** and **disadvantages** in terms of road safety of this new tyre.

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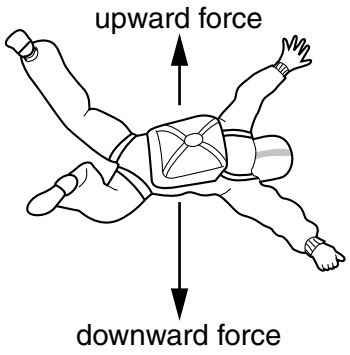
..... **[3]**

[Total: 6]

13 David is a parachutist.

He jumps out of an aeroplane.



(a) Write down the name of the **upward** force acting on David as he falls.

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

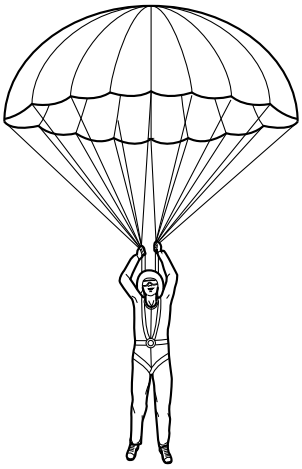
(b) David **reduces** the upward force.

Describe how he could do this.

.....

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

(c) David's terminal speed is 50 m/s. He now opens his parachute.



Explain what happens to his terminal speed **after** he opens his parachute.

.....

.....

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

[Total: 4]

END OF QUESTION PAPER

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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.