

THIS IS A NEW SPECIFICATION

**F**

Tuesday 22 January 2013 – Morning

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


Candidate forename		Candidate surname	
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Centre number						Candidate number				
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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 = $\frac{\text{useful energy output (} \times 100\% \text{)}}{\text{total energy input}}$

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

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

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

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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 onions.

He wants to grow onions to enter into a competition.

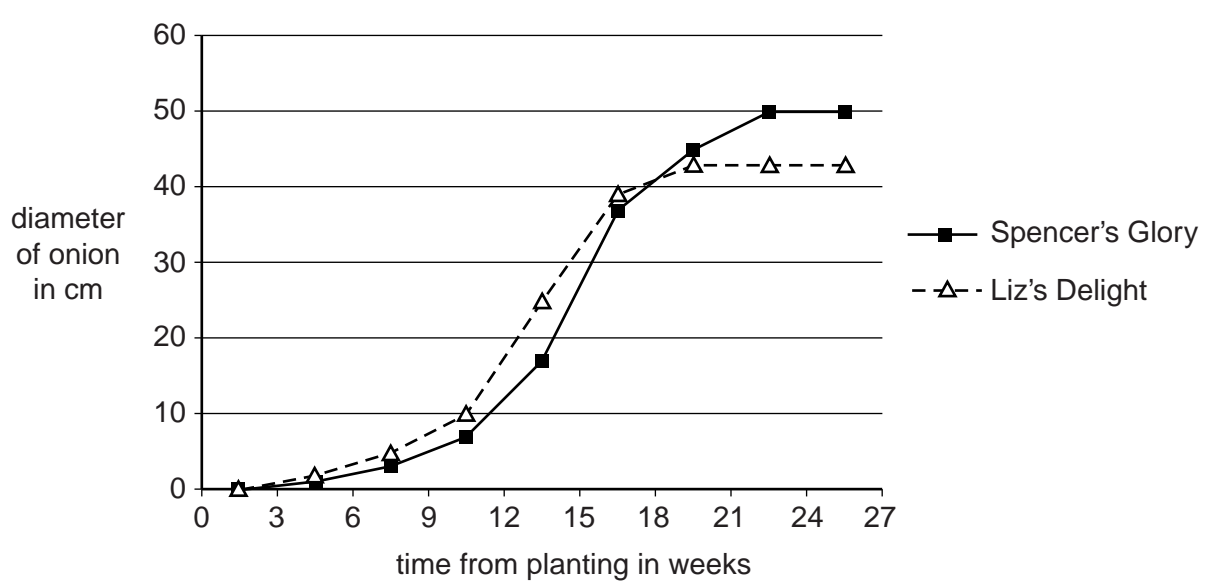


(a) Noel is growing two types of onion, Spencer's Glory and Liz's Delight.

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]

5

(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).

.....

.....

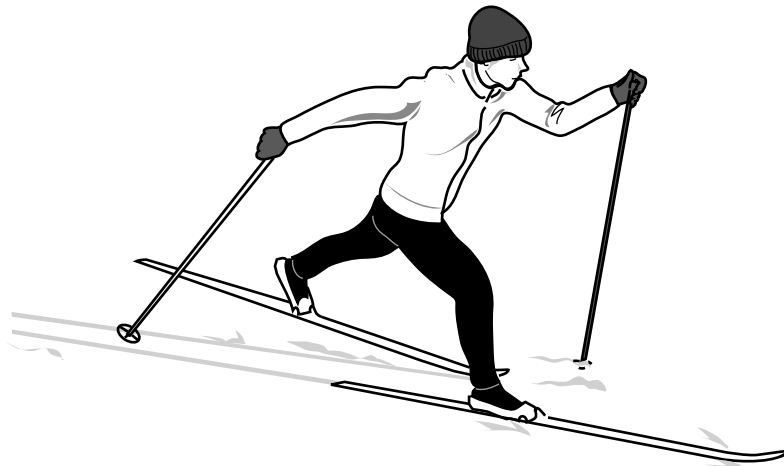
.....

..... [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 **VO₂ Max**.

The table shows typical ranges of VO₂ 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 VO₂ Max?

..... [1]

(ii) It is hard to measure VO_2 Max.

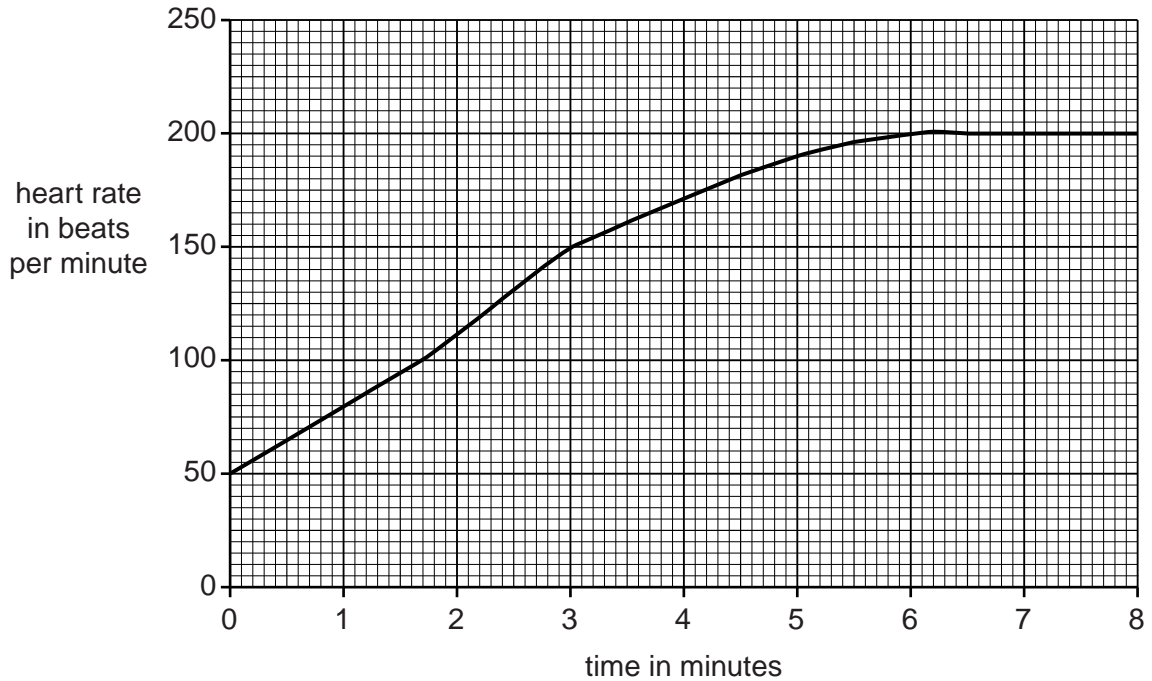
It can be estimated using the formula below.

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

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) Suggest why having a bigger heart helps cross-country skiers.

.....
..... [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]

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.

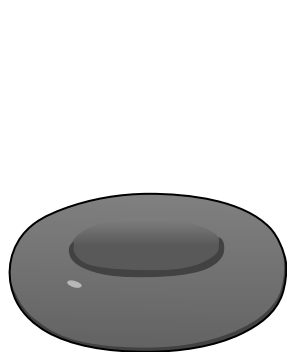
(a) Write down the name for a change in the structure of a gene.

..... [1]

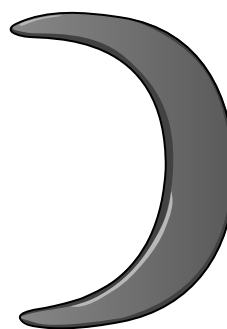
(b) Haemoglobin is found in red blood cells.

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.

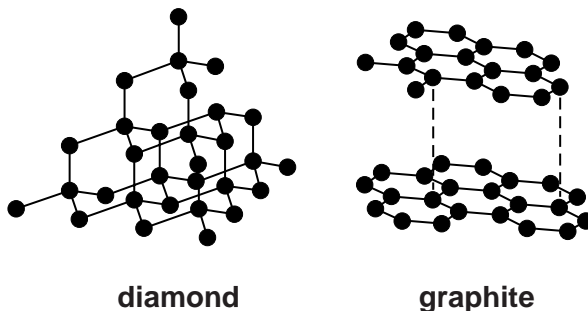
Suggest **one** reason why.

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

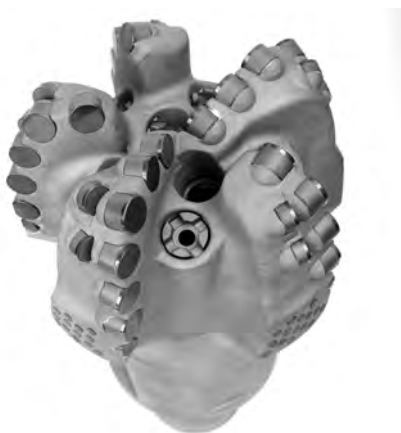
[Total: 4]

SECTION B – Module C3

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



(a) Diamond is used in cutting tools.



Explain why.

..... [1]

(b) Graphite does not dissolve in water.

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

.....

..... [2]

[Total: 3]

12

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



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

(ii) 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	

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]

13

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

Write down **one** reason why.

..... [1]

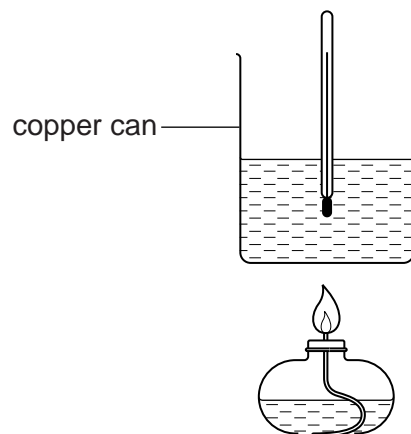
[Total: 7]

Question 7 begins on page 14

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

16

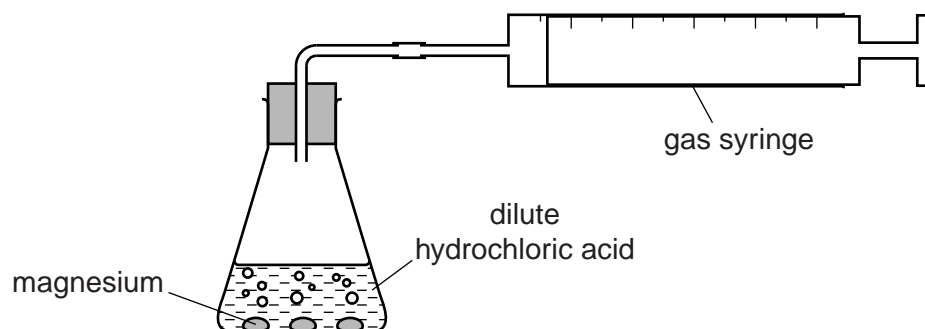
8 Jan and Mike investigate the reaction between magnesium lumps and hydrochloric acid.

Magnesium chloride solution and hydrogen gas are made.

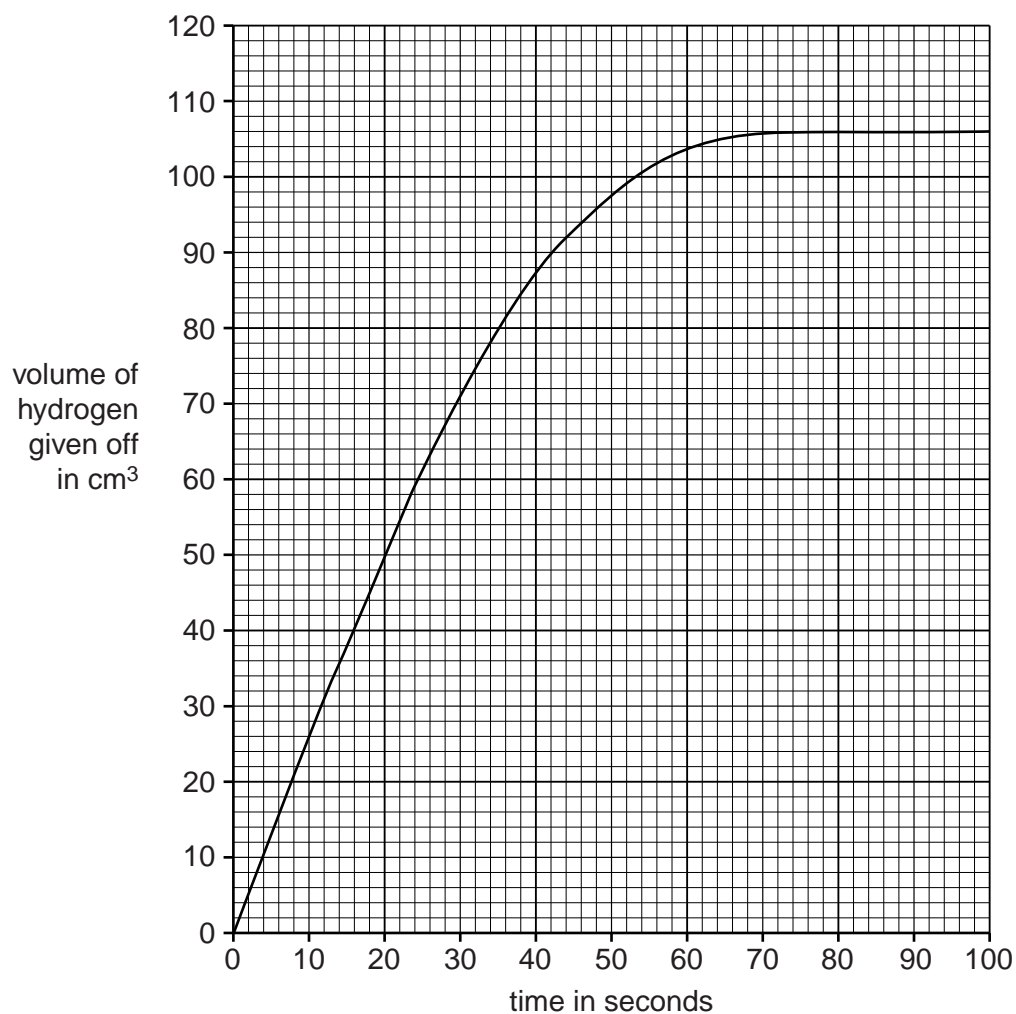
(a) Write a **word** equation for this reaction.

..... [1]

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



Look at the graph of their results



17

(i) How long does it take to make 50 cm³ of hydrogen?

..... seconds [1]

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

..... cm³ [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.

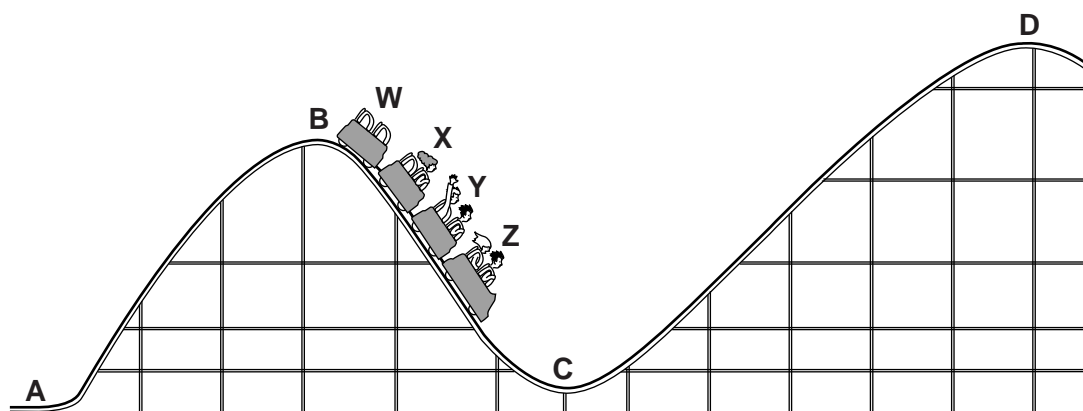
.....
.....
.....
..... [3]

[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

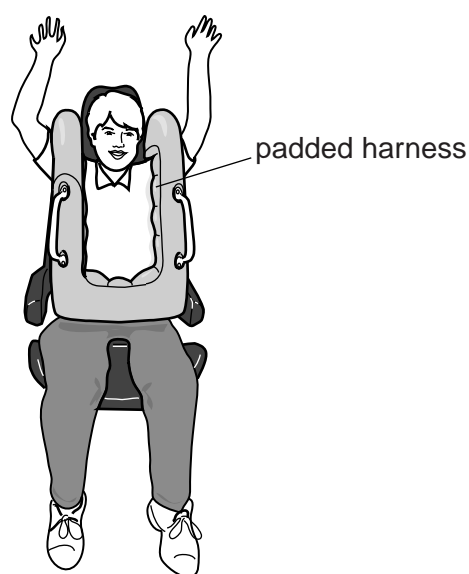
Which car has the greatest **momentum** as they move down the slope?

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]

- 11 There are many different types of hybrid cars available.



- (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.

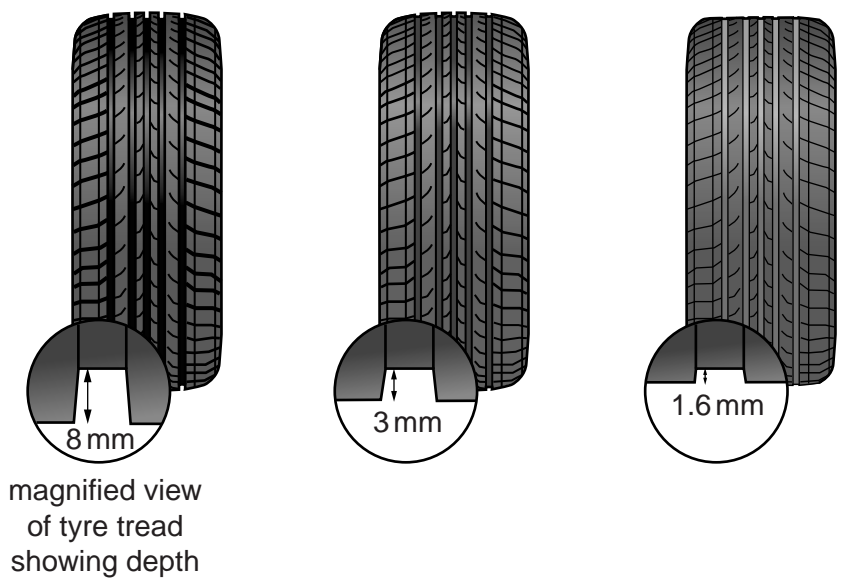
Complete the table to show your answers.

[3]

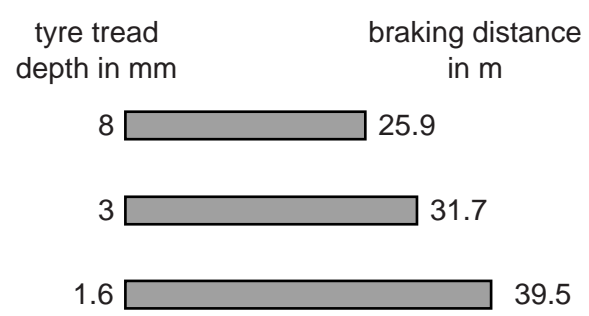
[Total: 4]

12 Car tyres have tread.

As tyres become worn the amount of tyre tread decreases.



(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]

23

(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

Due to technological advances a new tyre has been made.

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

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

.....

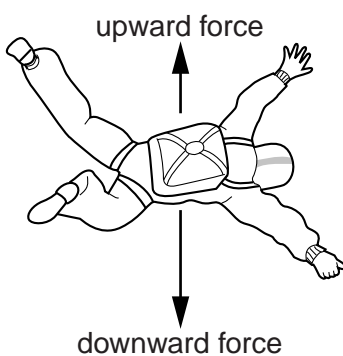
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..... [3]

[Total: 6]

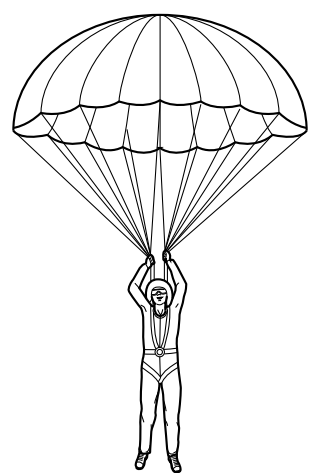
13 David is a parachutist.
He jumps out of an aeroplane.



(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]

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26

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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0											
	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		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		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		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	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	112 Cd cadmium 48	201 Hg mercury 80					
			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	201 Hg mercury 80						
			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							
			[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hasium 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																			

1	H	1
	hydrogen	

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.