OCR
Oxford Cambridge and RSA

F

Wednesday 15 June 2016 – 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

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

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

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

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Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

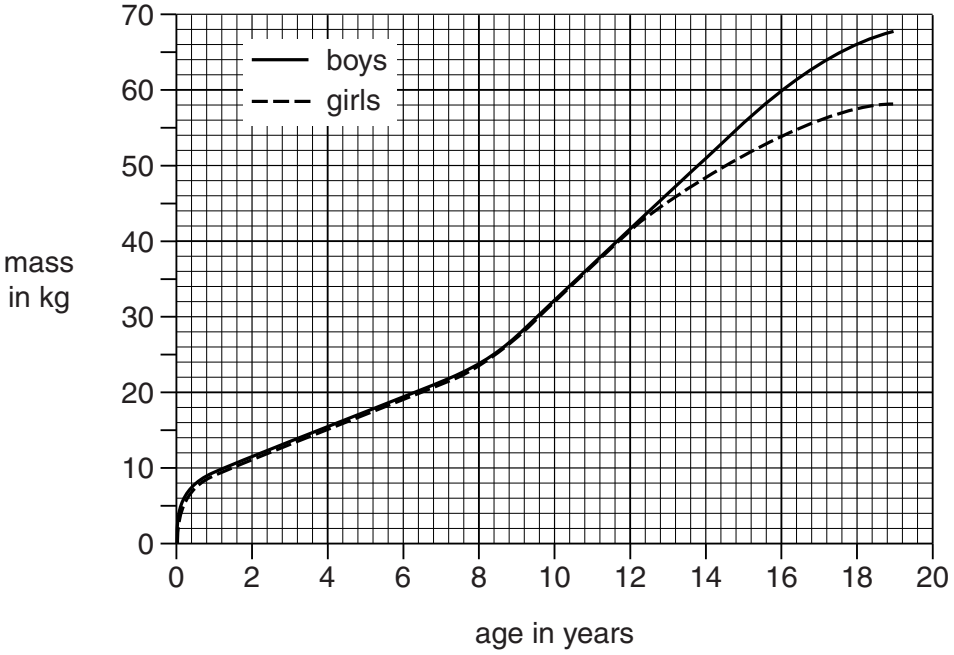
Answer **all** the questions.

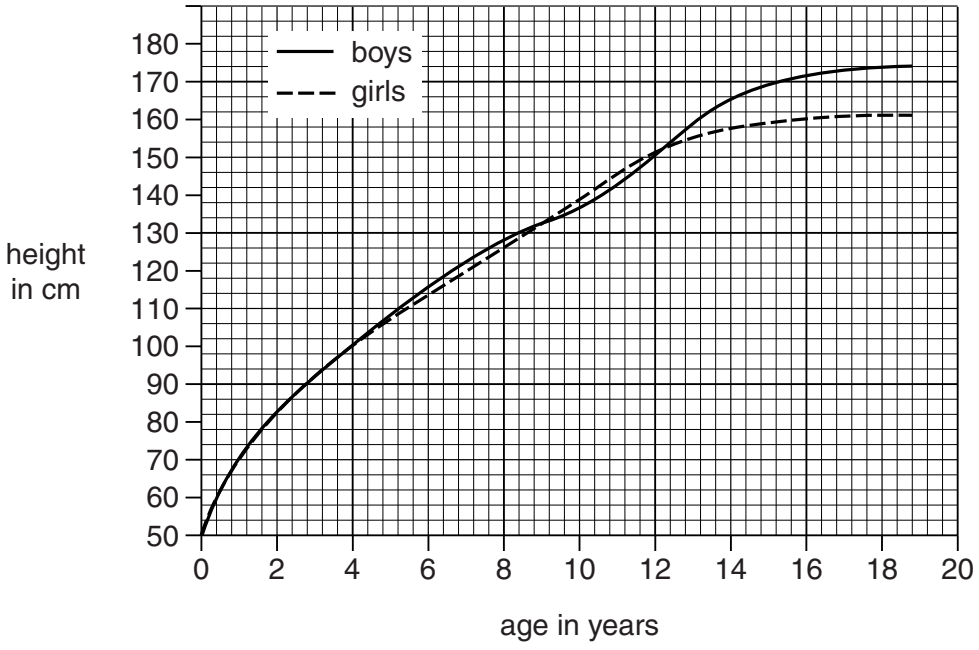
SECTION A – Module B3

1 This question is about growth in boys and girls.

Look at the graphs below.

They show how mass and height change as boys and girls grow.





(a) Write down the age when the mass of boys becomes greater than the mass of girls.

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

(b) Compare the growth in boys and girls during the first ten years.

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

(c) Cell division occurs throughout growth.

During which age range is cell division fastest?

Look at the list.

age range in years

0 to 2
4 to 6
6 to 8
12 to 14
16 to 18

Choose your answer from the list.

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

[Total: 4]

2 Mike competes in the triathlon.

This event involves swimming, cycling and running.

(a) Mike wants to make sure that his training will help him to improve.

Mike needs to keep within his target heart rate zone when training.

Look at the table below.

It shows predicted maximum heart rates and target heart rate zones.

Predicted maximum heart rate in beats per minute	**Target heart rate zone in beats per minute**
200	120 – 170
195	117 – 166
190	114 – 162
185	111 – 157
180	108 – 153

Table 2

To find his target heart rate zone, Mike must calculate his predicted maximum heart rate.

predicted maximum heart rate = 220 – age

Mike is 30 years old.

(i) What is Mike's **target heart rate zone**?

Use the predicted maximum heart rate formula and Table 2 above to help you to answer.

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

(ii) Mike measures his heart rate during each stage of his training.

Look at the table of his results.

	Heart rate in beats per minute
Swimming	110
Cycling	162
Running	160

Mike will gain the most benefit from his training if his heart rate stays within the target heart rate zone.

What changes should Mike make to his training to get the most benefit?

.....

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

(iii) Part of Mike's training is to measure his recovery time after exercise.

How could Mike measure his recovery time?

.....

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

(b) When Mike takes part in a triathlon the amount of aerobic respiration increases.

Explain why.

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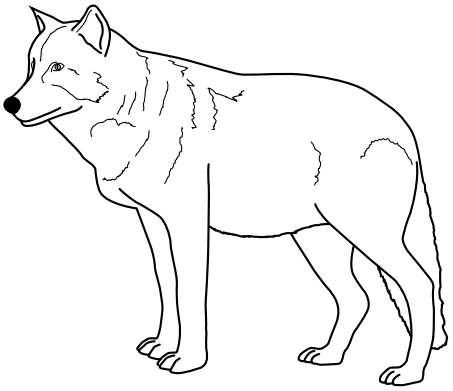
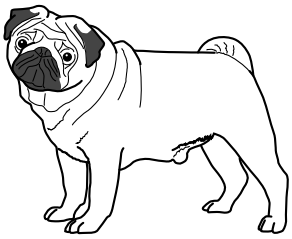
..... **[2]**

[Total: 7]

3 **(a)** Look at the pictures below.



grey wolf



pug

The grey wolf is a wild animal.

All dog breeds like the pug are thought to have been bred originally from the grey wolf.

Some pug dogs have difficulty breathing.

(i) Describe how humans could have bred a dog like the pug from the grey wolf.

Suggest why some pugs may have breathing problems.

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

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

(ii) The different characteristics of dogs may be caused by **mutations** in cells.

Complete the sentence.

Mutations are changes to ..... . **[1]**

(b) Dog skin cells have 78 chromosomes.

(i) How many chromosomes are in a dog sperm cell?

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

(ii) Put a (ring) around the word that describes dog skin cells.

acrosome **diploid** **fertilised** **gamete** **zygote**

[1]

[Total: 9]

Question 4 begins on page 10

4 (a) This question is about enzymes.

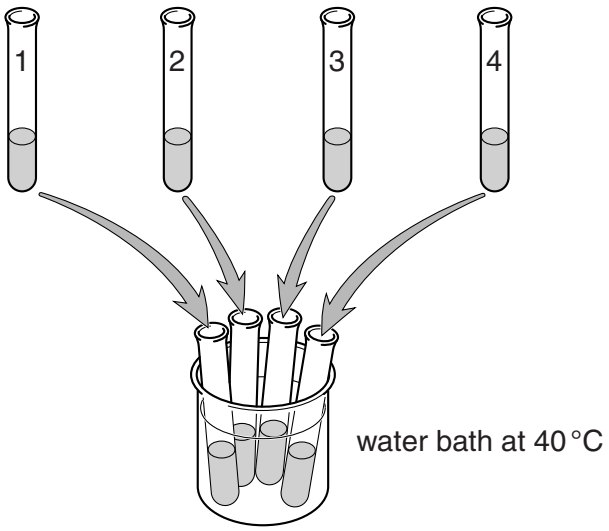
Pepsin is an enzyme that breaks down protein.

Egg-white is a protein that makes water cloudy.

Look at the table below.

It shows an investigation into the effect of adding the enzyme pepsin to egg-white.

Tube 1	Tube 2	Tube 3	Tube 4
5 cm^3 egg-white	5 cm^3 egg-white	5 cm^3 egg-white	5 cm^3 egg-white
3 drops distilled water	3 drops hydrochloric acid	3 drops hydrochloric acid	3 drops hydrochloric acid
1 cm^3 pepsin	1 cm^3 distilled water	1 cm^3 pepsin	1 cm^3 of boiled pepsin



The tubes were put in a water bath at 40 °C for 5 minutes.

Look at the results below.

Tube	Contents	Observations of tube contents	
		At start	At end
1	egg-white, water and pepsin	cloudy	almost clear
2	egg-white, hydrochloric acid and water	cloudy	cloudy
3	egg-white, hydrochloric acid and pepsin	cloudy	clear
4	egg-white, hydrochloric acid and boiled pepsin	cloudy	cloudy

(i) Write a conclusion explaining what the results show about the conditions pepsin needs to work.

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

(ii) How does the 'lock and key' mechanism explain why pepsin will **only** break down protein and **not** other food groups like starch?

You may draw a diagram to help your answer.

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

(b) Why were all the tubes kept at 40 °C?

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

[Total: 5]

SECTION B – Module C3

5 Pete and Helen investigate the reaction between marble chips (calcium carbonate) and nitric acid.

Calcium nitrate, carbon dioxide and water are made.

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

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

(b) Pete and Helen measure the mass of carbon dioxide made every 30 seconds during the reaction.

They do the experiment again.

They use the same amount of acid and marble chips.

This time they use **warm** nitric acid instead of cold nitric acid.

Look at the graph below. It shows their results.

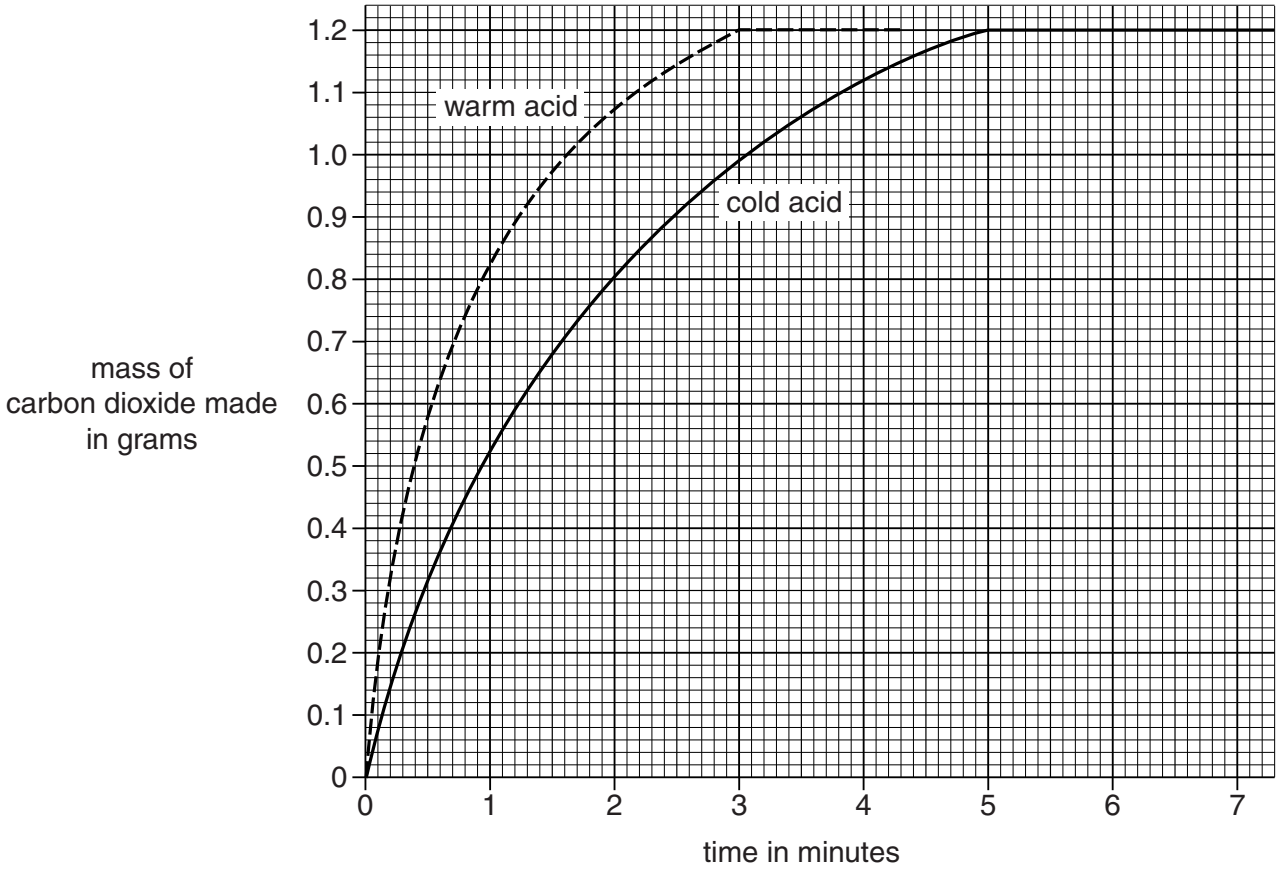

Fig. 5

Look at the graph in Fig. 5 for the **cold** acid.

(i) What mass of carbon dioxide is made after 1 minute?

answer ..... g **[1]**

(ii) When is the reaction **fastest**?

Tick (✓) the correct box.

between 0 and 1 minute	☐
between 1 and 2 minutes	☐
between 2 and 3 minutes	☐
between 3 and 4 minutes	☐

[1]

(iii) Pete thinks that the graph for the **cold** acid shows that the mass of gas made each minute is the same.

Is Pete right? Explain your answer.

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.....

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

(c) The reaction with warm acid stops after 3 minutes.

Explain why the reaction stops.

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

(d) The reaction with **cold** nitric acid is slower than the reaction with warm nitric acid.

Explain, in terms of the reacting particle model, why the reaction is **slower** with cold acid.

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

Turn over for the remainder of question 5

(e) Reactions are faster at **higher temperatures**.

Write down **two** other ways of making reactions faster.

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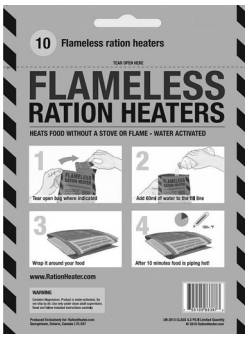
..... **[2]**

[Total: 9]

6 Soldiers use 'flameless heaters' to heat their meals.



The 'flameless heater' heats the food safely and quickly without using a flame.

The heater uses a chemical reaction between magnesium metal and water.

$$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$$

(a) Look at the equation.

Write down the formula for one **reactant** in this reaction.

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

(b) The reaction is **exothermic**.

What is meant by an exothermic reaction?

.....

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

(c) A scientist is trying to improve the 'flameless heaters' so that they heat the food more quickly.

Look at her results.

Heater	Temperature rise in the heater in °C	Time taken in minutes
A	40	8
B	42	7
C	24	6
D	50	10

Which heater heats up quickest?

Explain your answer using the temperature rise and time taken.

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

[Total: 4]

7 Pensby pharmaceuticals are making a new painkiller.

They make the drug using a **batch** process rather than a continuous process.

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

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

(b) It is often expensive to make and develop new drugs.

Explain **two** reasons why.

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

(c) Pensby pharmaceuticals investigate four different methods of making the new painkiller.

Look at the table below.

It gives information about the four methods they use.

Method	Predicted mass in g	Actual mass in g	Percentage yield	Atom economy
A	6.7	4.0	60%	50%
B	14.2	7.1	50%	85%
C	11.5	6.9	.....	40%
D	13.3	12.0	90%	80%

Use the information to calculate the percentage yield for method **C**.

Decide which method they should use to make the painkiller and explain your choice.

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

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

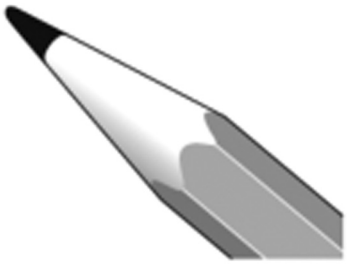
[Total: 10]

8 Diamonds are used in jewellery.

One physical property of diamond is that it is colourless.

Graphite is used in pencil leads.

One physical property of graphite is that it is slippery.



Diamond and graphite have some physical properties in common.

Write down **two** of these properties.

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

[Total: 2]

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Question 9 begins on page 20

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SECTION C – Module P3

9 This question is about work, energy and power.

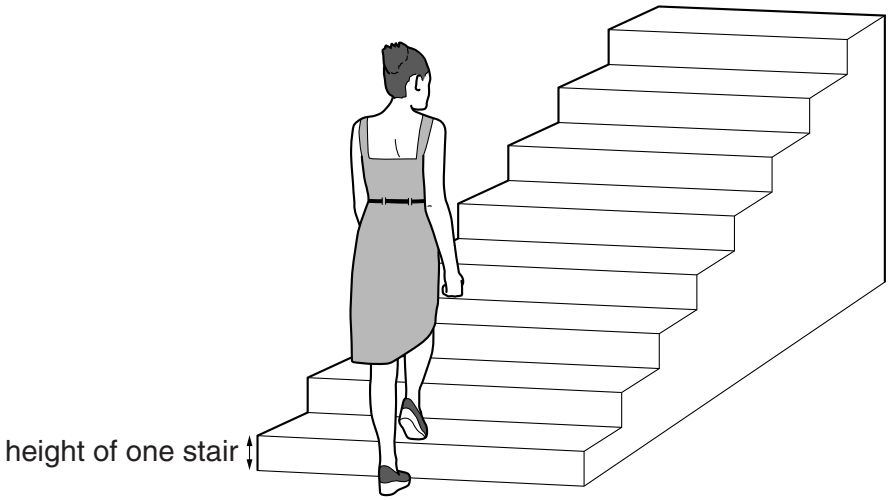
(a) What is the unit for energy?

Choose from

hertz **joule** **newton** **watt**

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

(b) Janna walks up stairs.



(i) The height of one stair is 0.15 m.

Janna walks up **four** stairs. She weighs 500 N.

Calculate the **work** done by Janna using this data.

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.....

answer ..... J **[2]**

(ii) Janna walks up another four stairs.

She has now walked up eight stairs.

Compare the amount of work done walking up eight stairs with the work done walking up four stairs.

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

(c) Janna walks up the stairs every day.

She walks at different speeds each day.

Look at the information below.

Day	Number of stairs	Time in seconds
Monday	8	4.2
Tuesday	8	4.4
Wednesday	8	4.1
Thursday	8	3.9
Friday	8	5.4

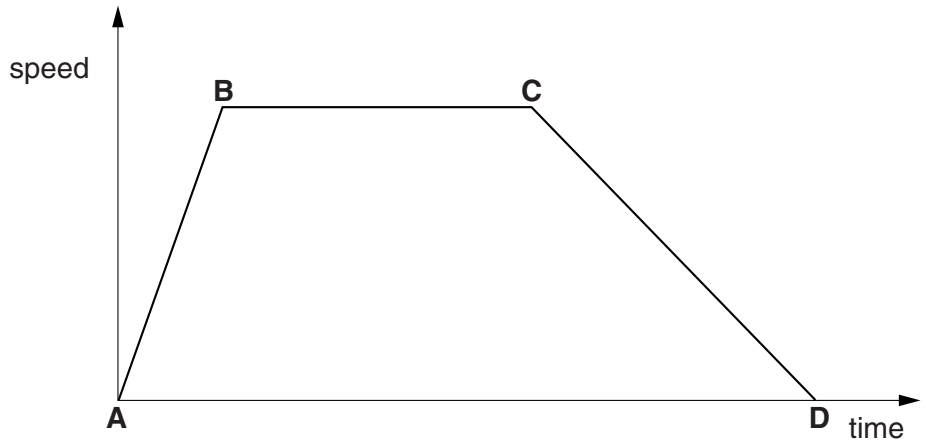
On which day did she develop the **most** power walking up the stairs?

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

[Total: 5]

Question 10 begins on page 22

10 Look at the speed-time graph below for a journey.



Describe the changes in speed **and** acceleration that take place during the whole journey.

Use letters **A**, **B**, **C** and **D** in your answer.

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

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

[Total: 6]

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Question 11 begins on page 24

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11 Seat belts are a safety feature in cars.

The design of seat belts has changed since they were first fitted in cars.

(a) Scientists collect test data to help them design new seat belts.

(i) Suggest methods the scientists use to collect valid test data for seat belts.

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

(ii) Why is it important for scientists to publish the test data they collect?

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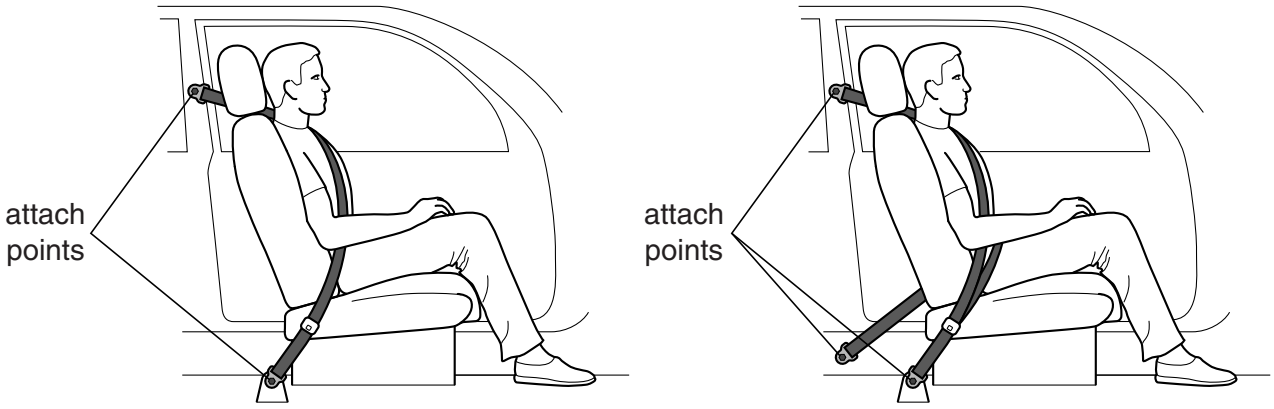
..... **[2]**

(b) Some seat belts are attached to the car in two places.

Others are attached in three places.

Look at the diagram below.



2-point seat belt **3-point seat belt**

Suggest why 3-point seat belts are better at reducing injuries.

.....

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

(c) Test data produced by scientists show that the material which seat belts are made from is important.

Write down one property which seat belt material must have and explain why seat belts are replaced after a crash.

.....

.....

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

(d) Cars have many different safety features.

Seat belts protect the driver in the car **during** an accident.

Write down the name of a car safety feature that is designed to **prevent** accidents.

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

[Total: 8]

Question 12 begins on page 26

12 Taran wants to buy a new car.

He uses the internet to find data about fuel consumption and emissions.

Look at the table below with the information he finds about two different car models.

Model R	Model S
Fuel consumption in litres per 100 km: • In town 5.7 • On motorways 4.1 • Combined 4.6 **Carbon dioxide emission** 124.0 g/km This vehicle is in the UK tax band D and this costs £110.00 a year.	**Fuel consumption in litres per 100 km:** • In town 8.2 • On motorways 5.2 • Combined 6.3 **Carbon dioxide emission** 149.0 g/km

(a) Taran looks at the data about **fuel consumption**.

(i) The fuel consumption for both models is measured in the same units.

Why is this important?

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

(ii) Write down **two** conclusions from the table about fuel consumption.

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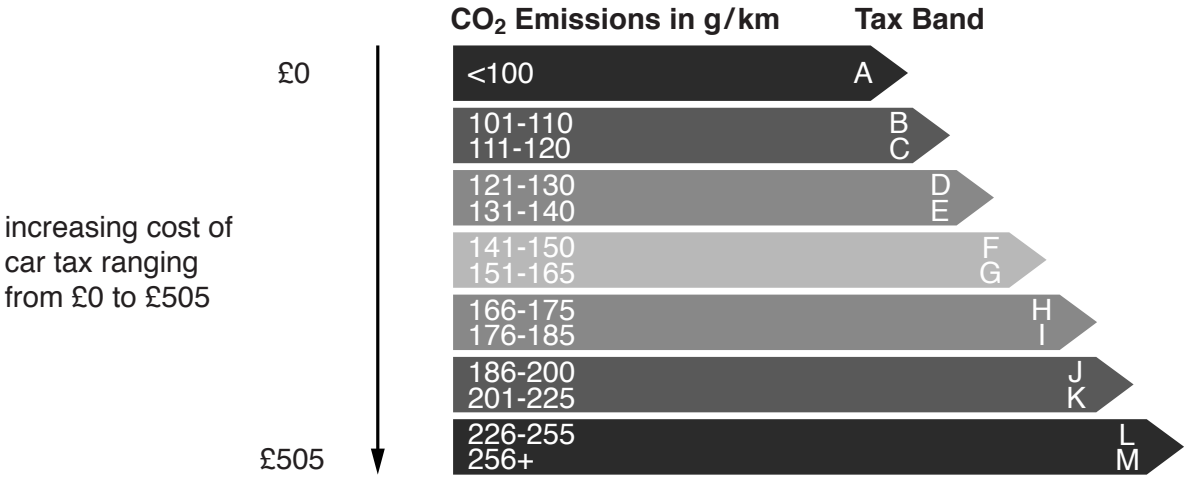
..... **[2]**

(b) Taran looks at the **carbon dioxide emissions** of the two cars, **Model R** and **Model S**.

He also uses the chart below to help him find the tax band for model **S**.



Use the information in the table and the chart to find the tax band for model **S** and use this to estimate the cost to buy tax for model **S**.

.....

.....

The tax band for model **S** is ..... and the estimated cost is £ ..... . **[2]**

(c) The kinetic energy (KE) of a car changes during its journey.

Suggest why the average kinetic energy of a car is less when travelling in a town compared to when travelling on a motorway.

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

[Total: 6]

END OF QUESTION PAPER

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.