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Thursday 13 June 2013 – Morning

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B721/02 Additional Science modules B3, C3, P3 (Higher Tier)

2383971382

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 02

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 **24** pages. Any blank pages are indicated.

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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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Answer **all** the questions.

SECTION A – Module B3

1 Look at the picture of chromosomes.

(a) Polar bears have 74 chromosomes in their white blood cells.

What is the haploid number for a polar bear?

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

(b) Chromosomes are made from a chemical called DNA.

Describe the structure of DNA. You may draw a labelled diagram.

.....

.....

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

(c) Collagen and insulin are two different proteins.

The production of these proteins is controlled by two different genes.

Describe how these two genes are similar and how they are different.

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

[Total: 6]

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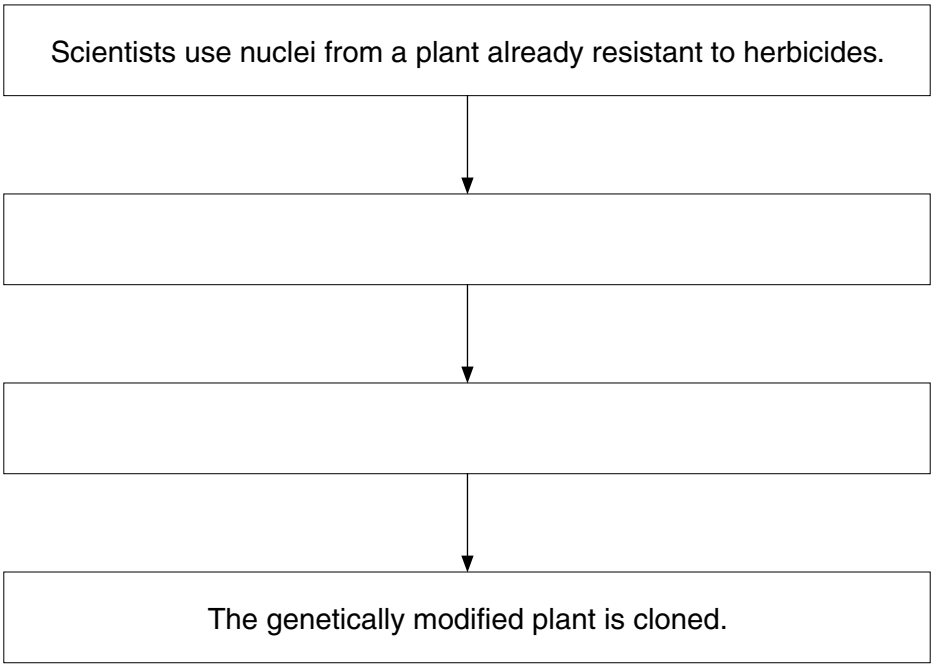
2 Soya beans are grown as food.

(a) Soya bean plants can be genetically modified to be resistant to herbicides.

Complete the flow chart to show the process.



[2]

(b) Some people do not think we should grow genetically modified soya bean plants.

This is because they think the soya beans could be harmful when eaten.

Write about **other** reasons why people may object.

.....

.....

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

[Total: 4]

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3 Jenny and Fred investigate plant growth using two identical plants.

They put plant **A** in a warm room and plant **B** in a cold room.

Both plants get the same amount of light, needed for photosynthesis and growth.

They use a ruler to measure the height of each plant once a week.

Look at their results.

Time in weeks	Height in cm	
	Plant A warm room (20 °C)	Plant B cold room (10 °C)
0	4.5	4.5
1	5.3	4.8
2	5.8	5.2
3	6.2	5.7
4	6.9	6.0
5	7.4	6.3

(a) The percentage increase for plant **A** after 5 weeks is 64.4%.

Calculate the percentage increase in growth for plant **B** after 5 weeks.

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

(b) Explain the differences in the growth. Use ideas about enzymes in your answer.

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

[Total: 5]

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4 Peter is investigating how exercise affects his pulse rate.

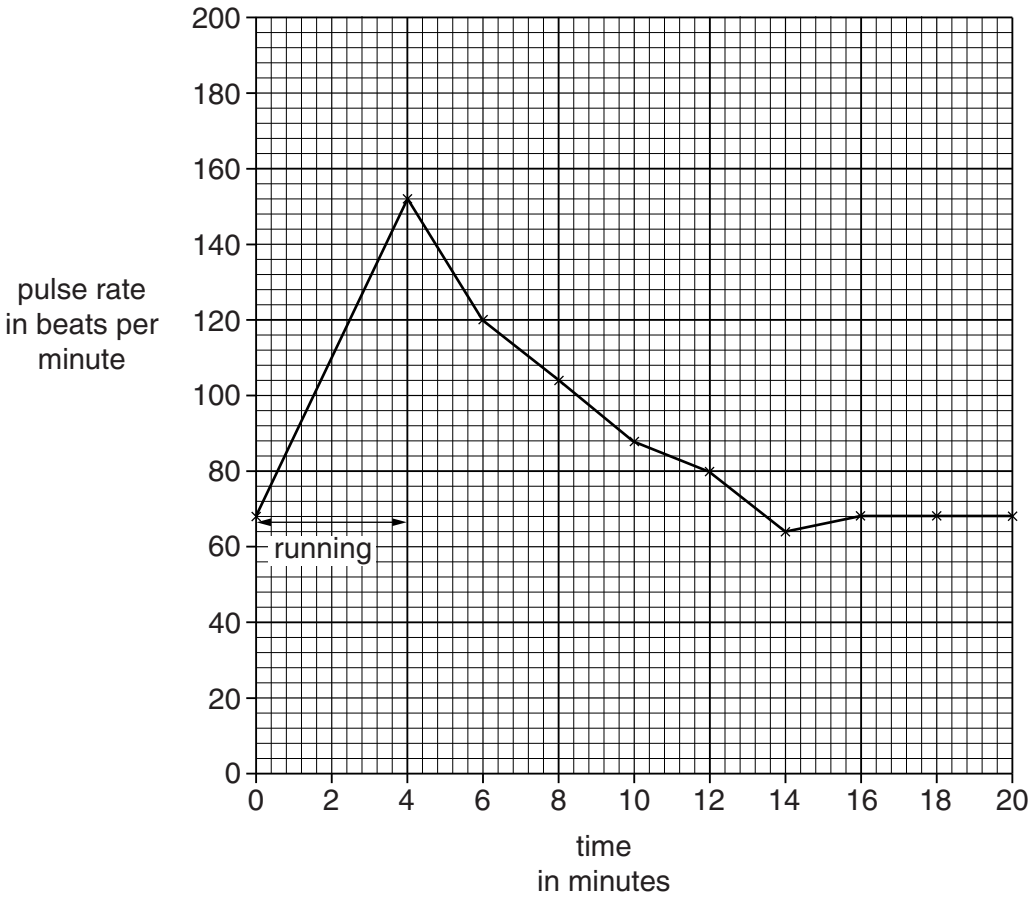
He uses a pulse meter to measure his pulse rate.

He runs as fast as he can for four minutes.

Peter's legs ache towards the end of the exercise.

He then sits down and measures his pulse rate again every two minutes for the next 16 minutes.

The graph shows his results.



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(a) Explain the pattern in the graph between 4 minutes and 20 minutes.

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

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

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(b) Peter then compares his recovery time after exercising for different lengths of time.

He does this by repeating his experiment but changing how long he exercises.

Look at his results.

Length of exercise in minutes	Recovery time in minutes
4	10
6	12
8	14
10	14

Predict his recovery time after 12 minutes of exercise.

Use your understanding of science to justify your answer.

.....

.....

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

(c) Peter finds out about blood circulation.

Humans have a double circulatory system.

Fish have a single circulatory system.

Explain the **disadvantages** of a single circulatory system.

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

[Total: 10]

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SECTION B – Module C3

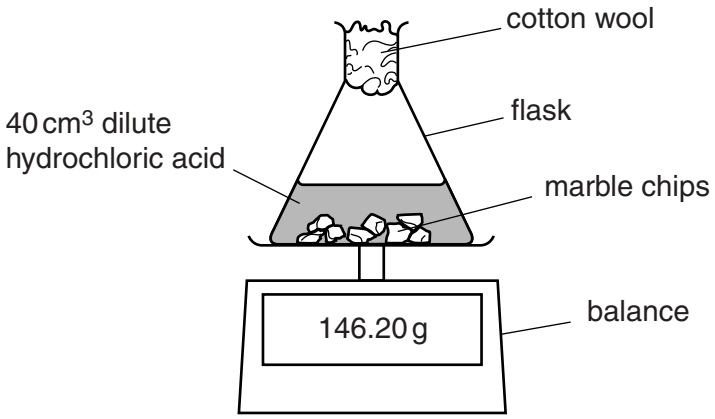
5 This question is about rates of reaction.

Julie and Trevor investigate the reaction between marble chips (calcium carbonate) and dilute hydrochloric acid.

They use 20.0 g of marble chips and 40 cm^3 of dilute hydrochloric acid.

The temperature of the acid is 25 °C.

Look at the diagram. It shows the apparatus they use.



They measure the mass every 50 seconds until the reaction stops.

They calculate the loss in mass.

Look at the graph on the next page.

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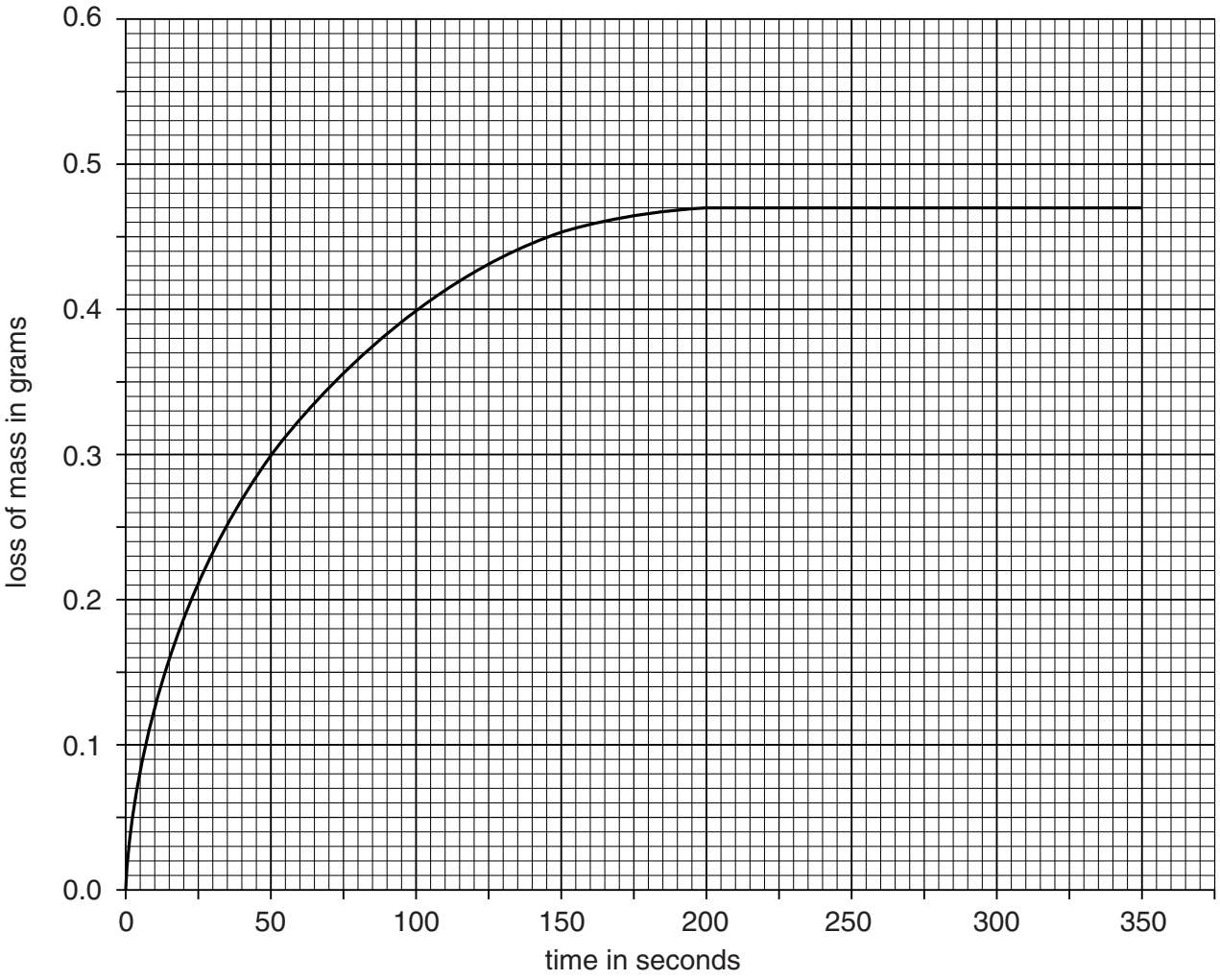

(a) How long does it take for the reaction to stop?

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

(b) Some marble chips are still left at the end of the experiment.

The hydrochloric acid is the **limiting reactant**.

What is meant by the limiting reactant?

.....

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

(c) Julie and Trevor repeat the experiment using 20.0 g of **larger** marble chips.

They use the same volume of hydrochloric acid at the same temperature.

On the grid sketch the curve they would get using the larger marble chips. **[2]**

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(d) Julie and Trevor can increase the rate of reaction between marble chips and hydrochloric acid by:

- increasing the concentration of the hydrochloric acid
- increasing the temperature of the hydrochloric acid.

Explain why both these methods increase the rate of this reaction. Use the reacting particle model in your answer.

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

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

[Total: 10]

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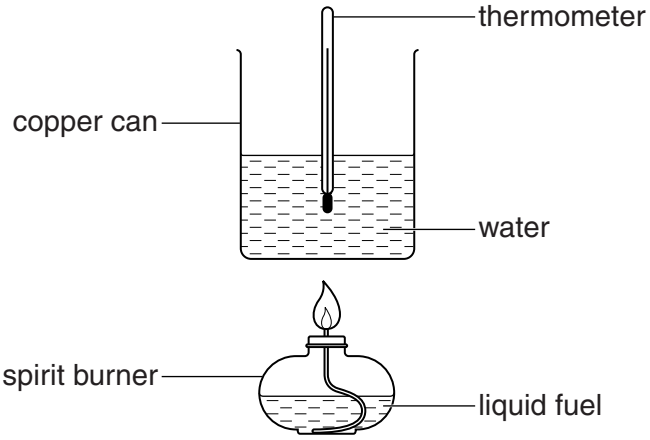
6 Mike wants to find a fuel to heat his garden shed.

He decides to investigate the energy given out by four different fuels.

Look at the diagram.

It shows the apparatus Mike uses.



Look at the table. It shows Mike's results.

Fuel	Temperature at start in °C	Temperature at end in °C	Mass of fuel burned in grams
A	18	38	1.1
B	22	42	0.9
C	16	36	0.6
D	25	45	0.7

(a) Look at the results for fuel **C**.

Mike calculates that fuel **C** transfers **4200 J** of energy to the water.

Use the equation

energy = mass × specific heat capacity × temperature change

to calculate the **mass of water** that Mike used in his experiment.

The specific heat capacity of water is 4.2 J/g °C.

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answer ..... g **[2]**

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(b) Burning fuels is an **exothermic** reaction.

Explain why burning fuels is an exothermic reaction. Include information about the bonds between atoms.

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

(c) Fuel **D** is ethanol, C_2H_6O.

Ethanol burns in oxygen, O_2.

Carbon dioxide and water are made.

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

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

[Total: 7]

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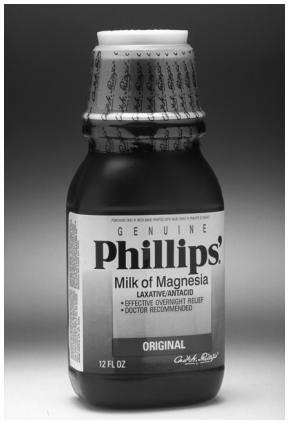
7 Milk of magnesia is an antacid that helps to relieve indigestion.



Milk of magnesia contains magnesium hydroxide, $Mg(OH)_2$.

A drug company makes magnesium hydroxide using the following reaction

$$MgCl_2 + 2NaOH \rightarrow Mg(OH)_2 + 2NaCl$$

The sodium chloride, $NaCl$, made is a **waste product**.

Look at the table of relative formula masses.

Substance	Relative formula mass, M_r
$MgCl_2$	95
NaOH	40
$Mg(OH)_2$	58
$NaCl$	58.5

(a) Calculate the **atom economy** for the manufacture of magnesium hydroxide.

.....

.....

.....

atom economy = ... % **[2]**

(b) John is a scientist working for the drug company.

He predicts that he should make 35 g of magnesium hydroxide.

He actually makes 21 g.

Calculate his **percentage yield** of magnesium hydroxide.

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percentage yield = ... % **[2]**

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(c) It is important for the drug company to have a high atom economy **and** a high percentage yield.

Explain why.

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

(d) The drug company wants to make a range of flu vaccines as cheaply as possible.

They need to be able to change their production of vaccines depending on:

- the demand for the vaccines
- the different types of flu each winter.

Look at the information about two possible processes for making flu vaccines.

Process	Cost to make 1 tonne of vaccine	'Down time' (time when machine is not running)	Daily production in tonnes	Can the amount of product made be varied?	How easy is it to change the product made?
Batch	£170	1 hour per day	250	yes	easy
Continuous	£95	3 hours per month	1000	no	difficult

The company decides to use a batch process for making a flu vaccine.

Use information from the table to give reasons for the company's decision.

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

[Total: 8]

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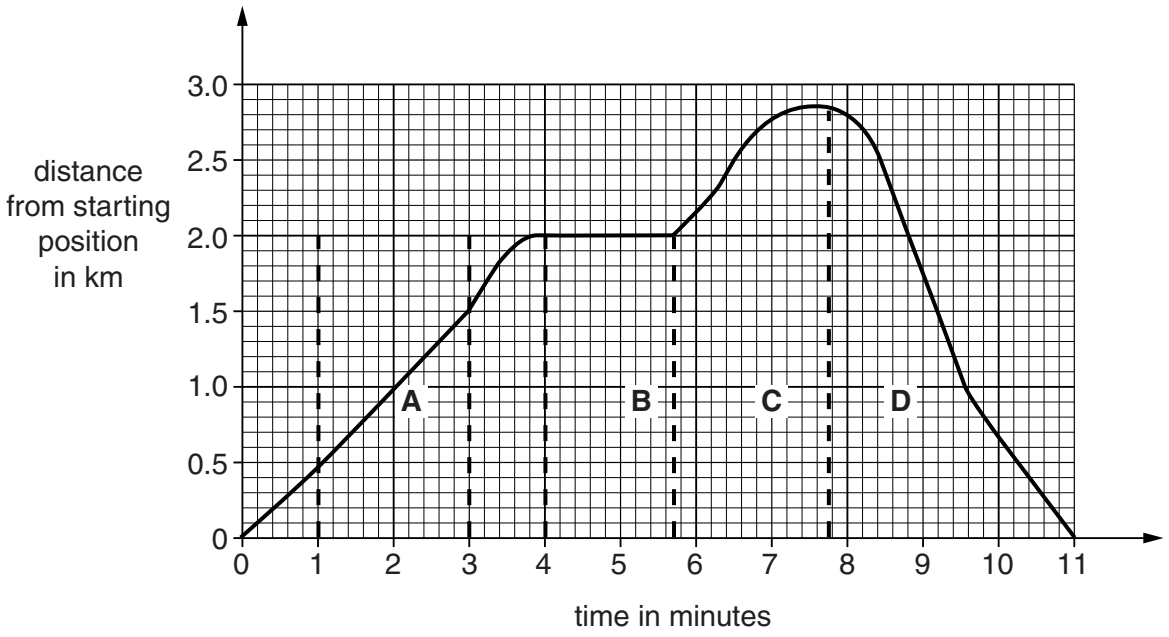
SECTION C – Module P3

8 Ravi drives his car on a straight road.

Look at the distance-time graph for his car journey.

There are four sections shown on the graph, **A**, **B**, **C** and **D**.



(a) Which **two** sections show the car either accelerating or decelerating?

Choose from **A**, **B**, **C** or **D**.

answer ..... and ..... **[1]**

(b) Calculate the car's speed in **m/s** for section **A** of the journey.

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speed ..... m/s **[3]**

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(c) Ravi sets off on another journey. His friend Lewis follows Ravi's car as shown in the diagram.

(i) What is the relative velocity of the two cars?

Choose from

0.7 **1.5** **5** **12.5** **25**

answer ..... m/s **[1]**

(ii) Explain your answer to **(i)**.

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

[Total: 7]

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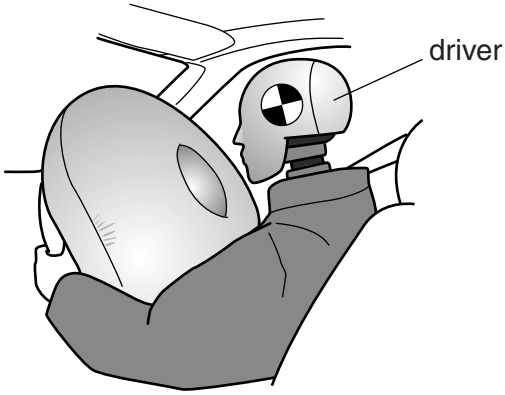
9 **(a)** Airbags are useful if a car is in a crash.



The table shows some information about a crash test carried out by a car manufacturer.

	Initial speed of driver in metres per second	**Mass of driver in kilograms**	**Time to stop driver's forward motion in seconds**
Without airbags	15	50	0.02
With airbags	15	50	0.05

Use the information in the table to describe and explain how airbags help to protect the driver in a crash. Use relevant calculations in your answer.

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

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

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(b) Seatbelts are another car safety feature that can be useful in a crash.

When seatbelts were first fitted to cars, not everyone thought that they were a good idea.

However, there was scientific evidence which showed the benefit of wearing seatbelts.

Suggest how governments have made society aware of the scientific evidence for wearing seatbelts. How have they encouraged people to wear seatbelts?

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

[Total: 8]

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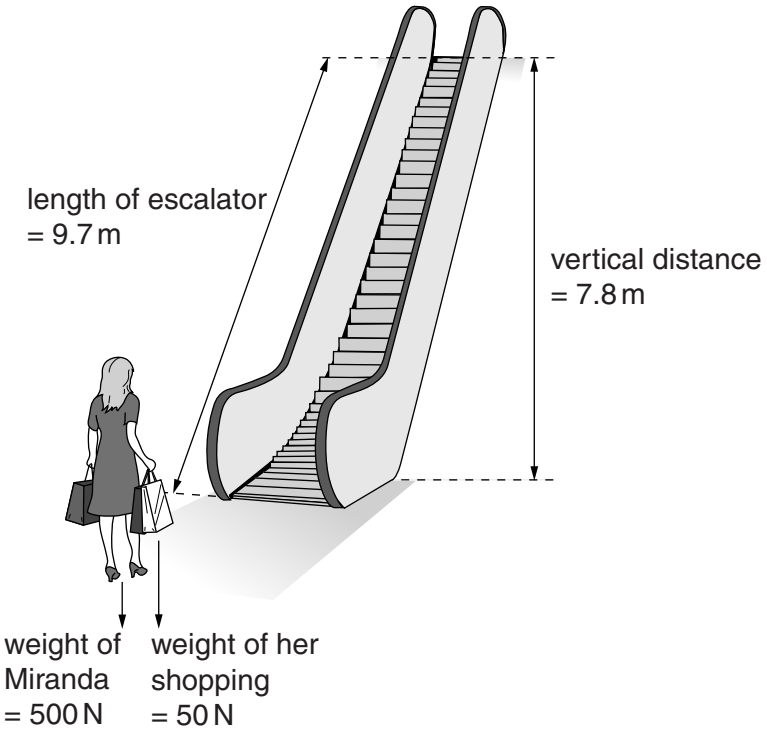
10 Miranda is shopping.

She travels up an escalator.



(a) Miranda carries her shopping from the bottom of the escalator to the top. It takes 8 seconds.

Calculate the extra power that the escalator motor must provide when Miranda and her shopping travel from the bottom to the top of the escalator.

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answer ..... W **[3]**

(b) What would happen to the value of the extra power calculated in **(a)**, if the escalator took 16 seconds to take Miranda and her shopping up to the top of the escalator?

answer .....

explanation .....

.....

.....

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

[Total: 5]

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11 Tanya and Sarah both test drive a car.

They drive the same car on roads in town and on the motorway. Look at the table.

Driver	Fuel consumption driving in town in km per litre	Fuel consumption for motorway driving in km per litre	CO_2 emissions for total journey in grams per km
Tanya	18	21	128
Sarah	16	18	138

(a) Use the data to suggest and explain why the two drivers obtain different fuel consumptions and CO_2 emissions for their test drives.

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

(b) Tanya drives along a road. She applies the brakes to stop the car.

The next day she drives along the same road and again brakes to stop the car.

Look at the data in the table.

	Speed in m/s	Thinking distance in metres	Braking distance in metres
Day 1	18	12	24
Day 2	18	15	30

Explain what could have produced the differences in the figures for these two days.

(i) Difference in thinking distance:

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

(ii) Difference in braking distance:

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

[Total: 5]

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.