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Wednesday 30 May 2012 – Afternoon

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

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

B7222280612

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

B721602

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.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

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

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

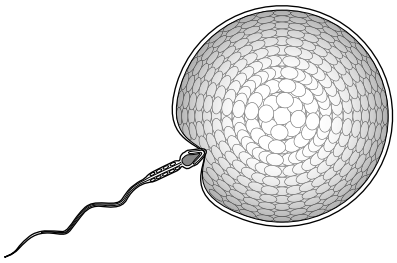
$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

Answer **all** the questions.

Section A – Module B3

1 Look at the picture.

It shows a sperm cell fertilising an egg cell.



(a) The sperm cell contains large numbers of mitochondria.

Explain why.

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

(b) After fertilisation an embryo forms.

Some scientists want to use embryonic tissue to treat medical conditions.

Some people object to the use of embryonic tissue.

Write down **one** reason why some people object.

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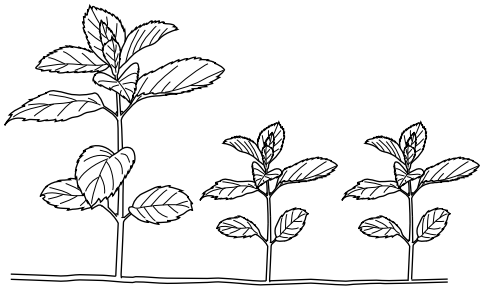
..... **[1]**

Turn over for the remainder of question 1

(c) Mint plants can make new individuals by asexual reproduction.



They grow genetically identical individuals.

Asexual reproduction involves mitosis not meiosis.

Meiosis is **not** used for this type of mint reproduction.

Explain why.

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

(d) Cloning is an example of asexual reproduction.

Mint could be cloned using tissue culture.

Describe how you could produce large numbers of plants using tissue culture.

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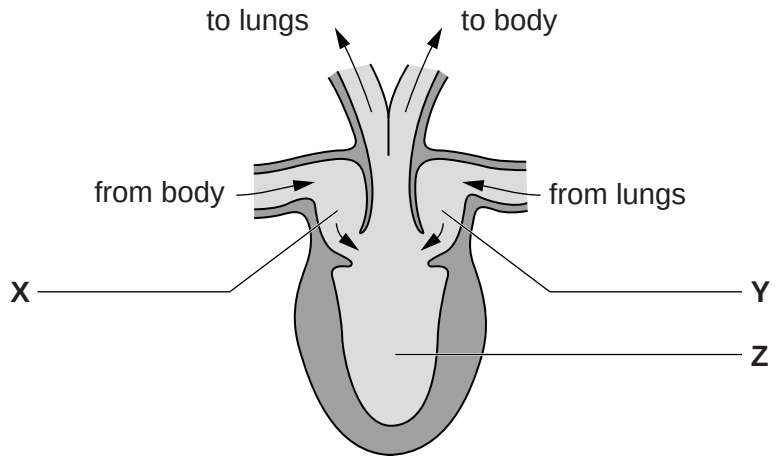
..... **[3]**

[Total: 6]

2 Look at the diagram of a section through a frog heart.



(a) The frog heart has some structures similar to a human heart.

The parts labelled **X** and **Y** both receive blood.

Write down the name for chambers **X** and **Y**.

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

(b) Look at structure **Z**.

(i) Describe how the frog heart is different from a human heart.

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.....

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

(ii) Suggest why this type of heart structure would be a disadvantage for humans.

.....

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

[Total: 5]

3 Look at the picture.

It shows two of the scientists that first worked out the structure of DNA.

(a) DNA is found in the nucleus of a cell.

The four DNA bases are used to code for enzymes.

Explain how enzymes are made.

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

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

(b) Scientists have found that some wild potato plants are resistant to a disease called blight.

Scientists want to stop crop potatoes from getting blight.

(i) Scientists can use **genetic engineering** to change the crop potatoes so they will be resistant to blight.

Describe how.

.....

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

(ii) Some people are concerned that there may be harmful side effects.

Suggest **one** harmful side effect of changing the crop potato plant by genetic engineering.

.....

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

[Total: 9]

4 Arjun investigates the effect of pH on an enzyme called catalase.

He uses catalase to break down hydrogen peroxide into oxygen and water.

Arjun records how much oxygen is collected in five minutes.

The table shows his results.

pH value	**volume of oxygen collected every 5 min in cm^3**			
	first attempt	**second attempt**	**third attempt**	**mean**
6	18.3	18.6	18.4	18.4
7	27.3	27.5	26.9	27.2
8	22.1	22.3	12.6	19.0
9	12.5	12.6	12.2	
10	7.4	7.1	6.9	7.1
11	3.1	3.3	3.0	3.1

(a) Arjun has calculated the mean for each pH except pH 9.

(i) Calculate the mean for pH 9.

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

(ii) Describe **and** explain the pattern seen in the **mean** results.

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

(b) When Arjun calculated the mean for pH 8 he used all three values.

Arjun's teacher tells him that he should **not** have done that.

Explain why his teacher gave him this advice.

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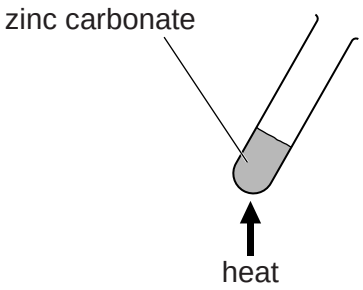
..... **[2]**

[Total: 5]

Section B – Module C3

5 Michael investigates the decomposition of zinc carbonate, $ZnCO_3$.

Look at the apparatus he uses.



(a) The equation for the decomposition is

$$ZnCO_3 \rightarrow ZnO + CO_2$$

The relative atomic mass, A_r, of Zn = 65, C = 12 and O = 16.

Show, by calculation, that 0.90 g of zinc carbonate should make **0.58 g** of zinc oxide, ZnO.

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

(b) Michael predicts that he should make 0.58 g of zinc oxide.

Michael actually makes 0.50 g of zinc oxide.

Calculate his **percentage yield**.

.....

.....

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

[Total: 4]

6 Christina investigates the reaction between magnesium and hydrochloric acid.

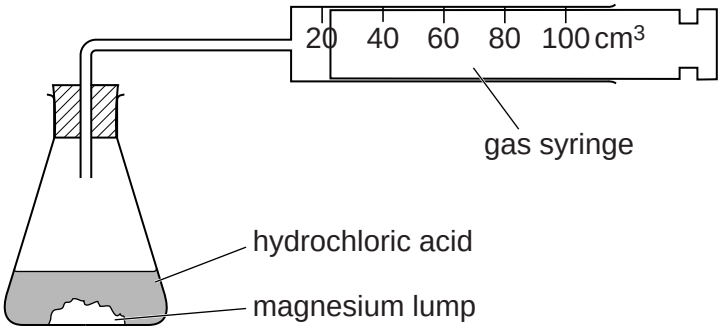
Magnesium chloride and hydrogen are made.

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

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

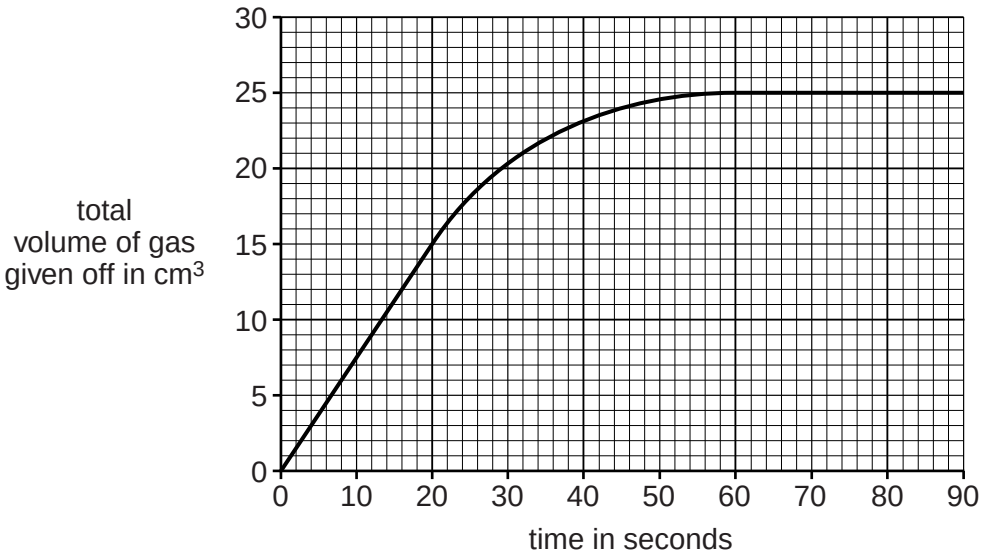
(b) Look at the diagram.

It shows the apparatus Christina uses.



She measures the volume of gas in the syringe every 10 seconds.

Look at the graph. It shows her results.



(i) At what time did the reaction finish?

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

(ii) Calculate the **rate of reaction** for this reaction during the time interval **0 – 20 seconds**.

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answer ..... cm^3/s **[1]**

(c) Christina repeats the experiment.

This time she uses **powdered** magnesium.

The reaction is much faster.

Use ideas about the collision theory model to explain why.

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

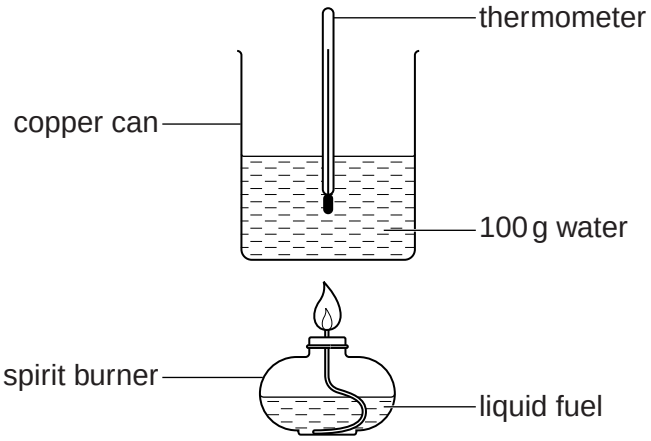
[Total: 6]

7 **(a)** Sahid investigates a fuel.

He wants to find out how much energy this fuel gives out.

The diagram shows the apparatus he uses.

Sahid burns 2 g of the fuel.



Look at the table.

It shows his results.

starting temperature of water in °C	**final temperature of water in °C**
20	38

Calculate the amount of heat energy transferred to the water by the fuel.

Use the formula:

energy = mass × specific heat capacity × temperature change

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

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

(b) During any chemical reaction bonds are broken and bonds are made.

Burning fuels is an **exothermic** reaction.

Explain why.

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

[Total: 5]

8 This question is about pharmaceutical drugs.

(a) Morphine is a pharmaceutical drug.

It is a powerful pain killer extracted from poppies.

A pharmacist extracts three samples of morphine, **A**, **B** and **C**, from poppies.

Look at the table. It shows the melting points of pure morphine and samples **A**, **B** and **C**.

morphine sample	melting point in °C
pure morphine	250
sample **A**	260
sample **B**	249
sample **C**	244

Suggest how the pharmacist extracts the morphine from the poppies and explain which sample, **A**, **B** or **C**, is the most pure.

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

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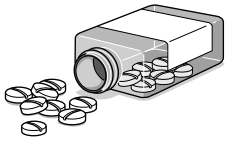
..... **[6]**

(b) Aspirin, a commonly used pharmaceutical drug, was originally extracted from willow bark.



Aspirin is sold in large quantities at a low price.

Look at the table.

It shows features of batch and continuous processes.

feature	batch	continuous
set up costs	low	high
capacity	made on demand	made 24 hours a day, 7 days a week
running costs	high	low
labour costs	high	low

Should aspirin be made by a batch process or a continuous process?

Justify your answer.

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

(c) Scientists researching new drugs often publish their findings.

Explain why.

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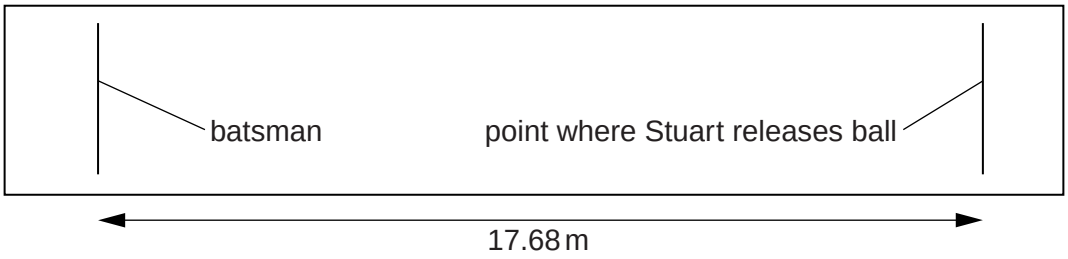
..... **[2]**

[Total: 10]

Section C – Module P3

9 Stuart is a keen cricketer.

In a match he bowls a cricket ball at a batsman.



(a) The ball's speed was measured.

The ball left Stuart's hand at a speed of 41 m/s.

It reached the batsman at a speed of 37 m/s.

Calculate the time taken for the cricket ball to reach the batsman.

Give your answer to **two** decimal places.

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answer ..... seconds **[3]**

(b) The batsman needs 0.48 seconds to react and hit the cricket ball.

Was the batsman able to hit the cricket ball?

answer .....

explanation

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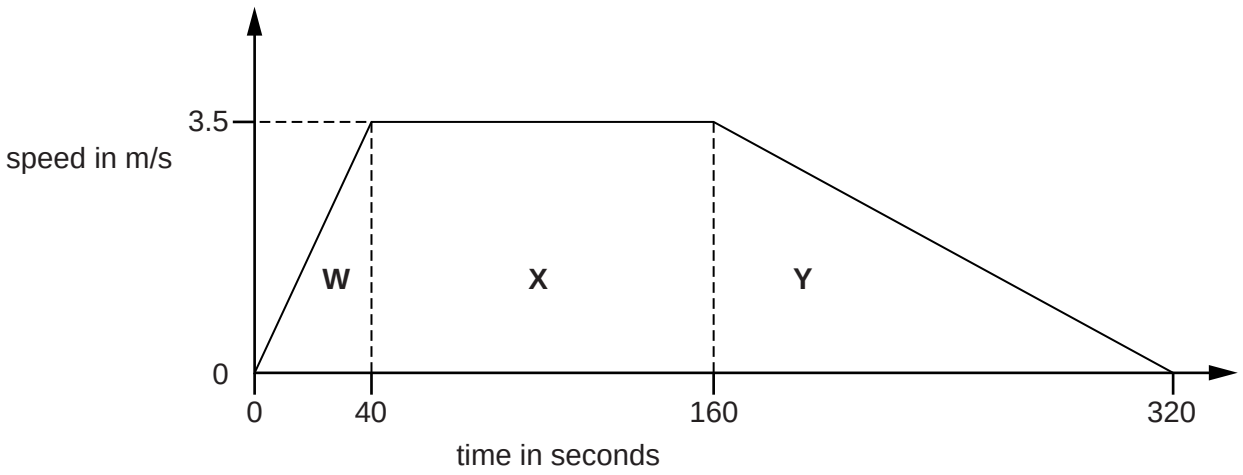
..... **[1]**

[Total: 4]

10 Jessica is an athlete.

The graph shows the speed of Jessica during a training run.



(a) Jessica travels 70 m in part **W** of the graph.

Describe how this can be found from the graph.

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

(b) Compare the distance in part **W** with the distance travelled in the other two parts of the graph.

Use calculations in your answer.

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

[Total: 4]

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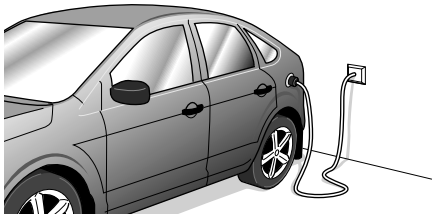
11 Look at the diagram of an electric car being charged.



In the future, electric cars will increasingly be used instead of cars that run on petrol or diesel.

Write about the arguments for and against the use of electric cars **and** how scientists can determine if the use of electric cars is a benefit to the environment.

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

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

[Total: 6]

12 This question is about cars, speed and road safety.

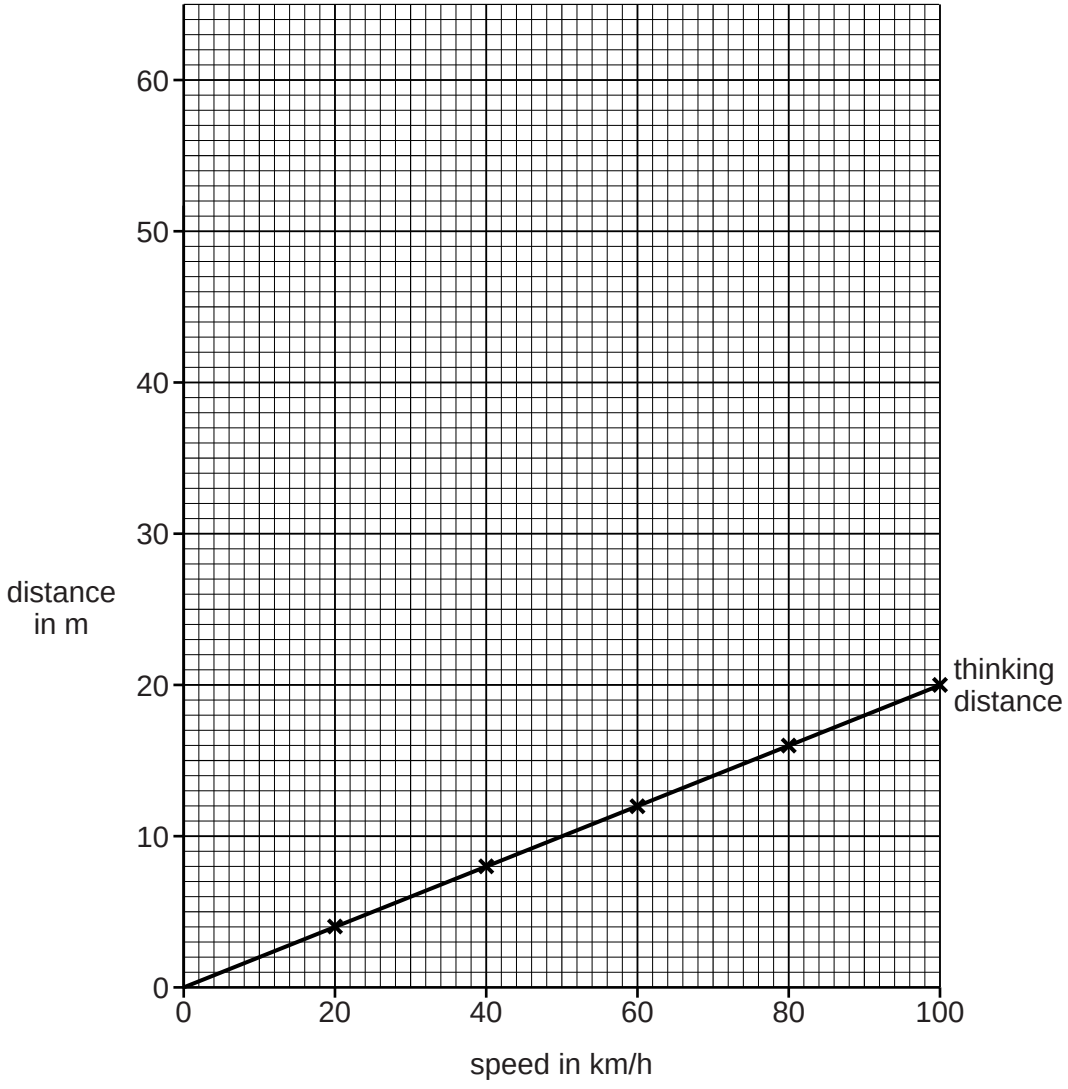
(a) Look at the table.

It shows speeds and distances for a car travelling on a dry road.

speed in km/h	thinking distance in m	braking distance in m	stopping distance in m
20	4	2.5	6.5
40	8	10.0	18.0
60	12	22.5	34.5
80	16	40.0	56.0
100	20	62.5	82.5

Plot the points and draw the graph for the **braking distance** on the axes below.

The graph of thinking distance has been done for you.



[2]

(b) Use the information in part **(a)** to explain which quantity has the greatest effect on stopping distance as speed increases.

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

(c) Scientists obtained the figures for braking and stopping distance on a dry road by doing test runs with cars.

This information is used to inform drivers about safe driving.

(i) How do these scientists ensure that they can be confident about their conclusions about safe driving?

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

(ii) What would scientists need to do to make further predictions about braking distance for different driving conditions?

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

(d) Crumple zones on cars can reduce injury to drivers and passengers.

The crumple zones reduce the forces on these people in a crash.

Explain how.

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

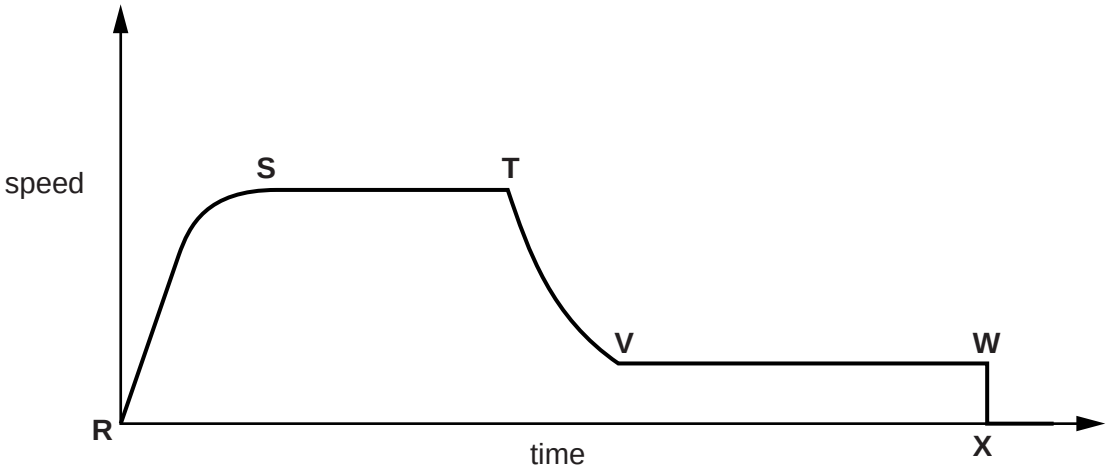
[Total: 8]

13 Haroon is a skydiver.

He jumps from a plane.

At some point during his fall he opens his parachute.

Look at the graph that shows his speed during his descent.



Use the letters **R**, **S**, **T**, **V**, **W** and **X**.

(a) What two parts of the graph show when Haroon was moving with the forces of drag and weight balanced?

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

(b) Where was there a big increase in drag force on Haroon due to an increased surface area?

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

(c) When did Haroon experience an increasing drag force due to him accelerating?

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

[Total: 3]

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.