OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B721/01

Unit B721: 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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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 for each question 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.

Examiner's Use Only:			
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7			
Total			

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

$$KE = \tfrac{1}{2} mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

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

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

Answer **all** the questions.

Section A – Module B3

1 This question is about blood and the heart.

(a) Which **one** is a true statement about the heart?

Put a tick (✓) in the box next to the true statement.

It is the largest organ in the body.	☐
The right side pumps blood to the lungs.	☐
The left side pumps blood to the lungs.	☐
Arteries take blood back to the heart.	☐

[1]

(b) Blood contains different types of cells.

One type of cell is the red blood cell.

Describe the **jobs** of **two** other components of the blood.

.....

.....

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

(c) Red blood cells contain haemoglobin.

Some people have mutations in the genes for haemoglobin.

These mutations stop the haemoglobin working properly.

Suggest what effect this has on the people with the mutations.

.....

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

[Total: 5]

2 The table shows some of the structures found in cheek cells.

It also shows the width of these structures.

structure	**width in mm**
ribosomes	0.00002
nucleus	0.005
mitochondria	0.001
chromosomes	0.00001

(a) Write down the function of the mitochondria.

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

(b) **(i)** A light microscope allows a person to see objects as small as 0.001mm.

Which of the structures shown in the table can be seen with a light microscope?

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

(ii) In 1953, Watson and Crick worked out the structure of DNA.

To do this, they needed to use X-ray data obtained by other scientists.

They could not use a light microscope to work out the structure of DNA.

Explain how the information in the table shows that they could not use a light microscope to study DNA.

.....

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

[Total: 4]

3 The table shows information about four varieties of blueberries.

variety	part of the season when fruit is ready	fruit	can be harvested by machine
Spartan	early	large with tangy flavour	yes
Toro	midseason	medium size and sweet	no
Bluecrop	midseason	large but bitter	yes
Northblue	midseason	small with wild blueberry taste	no

Sandra is a commercial grower.

She grows all four blueberry varieties to sell to supermarkets.

(a) Sandra wants to grow a new variety of blueberry.

She uses selective breeding to produce blueberries that are large and sweet.

Write down **two** varieties she could use in her breeding program.

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

(b) A supermarket has asked Sandra to produce large blueberries with a wild blueberry taste for early in the season.

Sandra would like to be able to harvest the blueberries using machines.

Sandra is deciding between two methods to produce the new variety:

- genetic engineering
- cloning.

Which method would be most appropriate for her to use to produce the new variety?

Explain your answer.

.....

.....

.....

.....

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

(c) Some people are worried about genetic engineering.

Describe **one** possible reason why they are worried.

.....

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

[Total: 5]

4 This question is about human reproduction.

The diagram shows a sperm cell.

Sperm cells are adapted to join with an egg cell. One example of an adaptation is that they have a tail for swimming.

Body cells, like cheek cells, are not adapted to join with an egg cell.

Write about the differences between a sperm cell and a body cell and how these differences make a sperm cell adapted to join with an egg.

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

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

[Total: 6]

5 Gary wants to measure his pulse rate.

(a) Describe how he can measure his pulse rate.

.....

.....

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

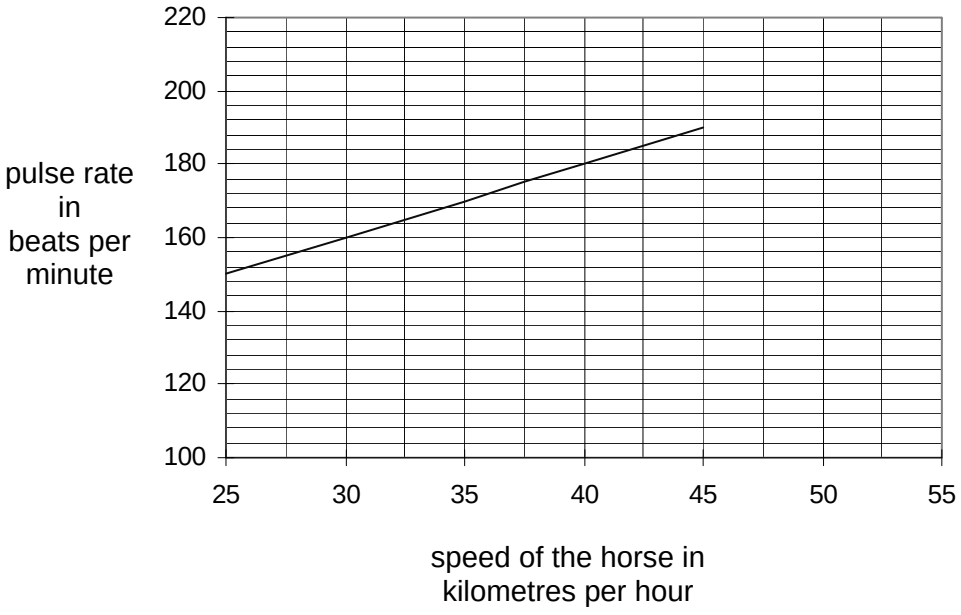
(b) Racehorses are bred and trained to run in races.

Trainers measure each horse's pulse rate to find out how fit the horse is.

They measure the pulse rate when the horse is running at different speeds.

This tells them how fast the horse can get oxygen to its muscles.

Some results for a horse are shown on the graph.



(i) Describe how the pulse rate changes as the horse runs faster.

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

(ii) Trainers know that a horse runs best when its muscles are receiving enough oxygen.

Above 200 heart beats per minute, a horse starts to rely on **anaerobic** respiration.

Use the graph to estimate the maximum speed at which this horse can run without relying on anaerobic respiration.

Show on the graph how you work out your answer.

Answer = ... km per hour **[2]**

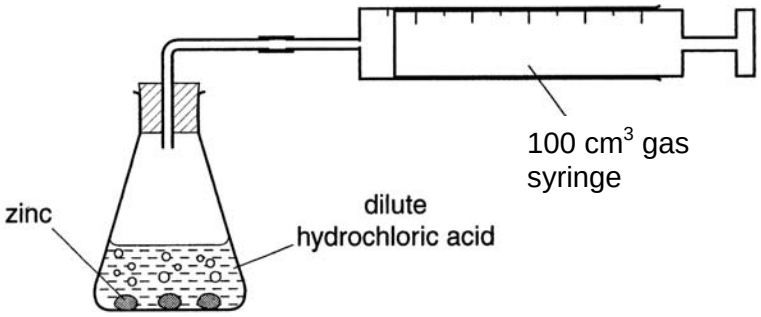
[Total: 5]

Section B – Module C3

6 Colin and Ann investigate the reaction between zinc lumps and hydrochloric acid.

Hydrogen and a solution of zinc chloride are made.

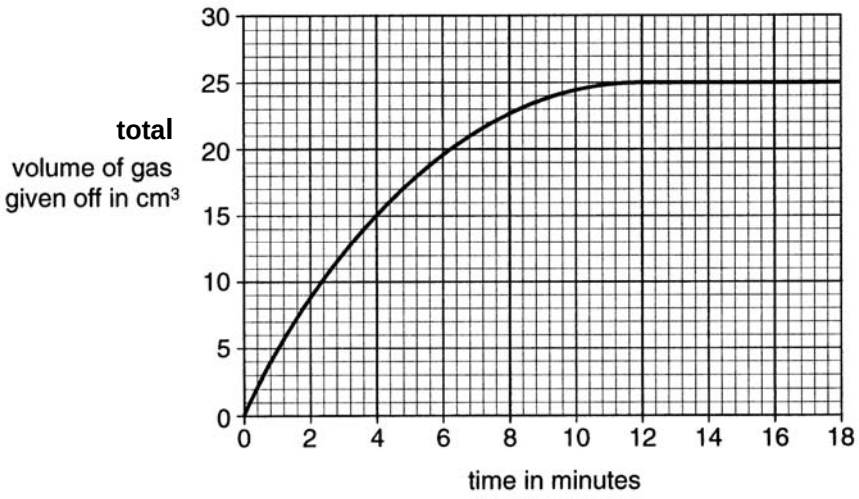
The diagram shows the apparatus they use.



Look at the graph.

It shows their results when 1 g of zinc lumps reacts with 20 cm^3 of dilute hydrochloric acid.

At the end of the experiment almost all of the zinc remained.



(a) How long does it take to make 20 cm^3 of gas?

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

(b) why does the reaction stop?

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

(c) Colin and Ann repeat the experiment.

This time they use **100** cm^3 of dilute hydrochloric acid rather than **20** cm^3.

Why would it be difficult to collect all of the hydrogen made at the end of this experiment?

.....

.....

.....

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

(d) Colin and Ann want the reaction to go faster.

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

Explain using the reacting particle model, two ways Colin and Ann can increase the rate of reaction.

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

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

(e) The reaction between zinc and hydrochloric acid goes at a reasonable rate.

Write down the name of one reaction which is **very slow** and one which is **very fast**.

.....

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

[Total: 12]

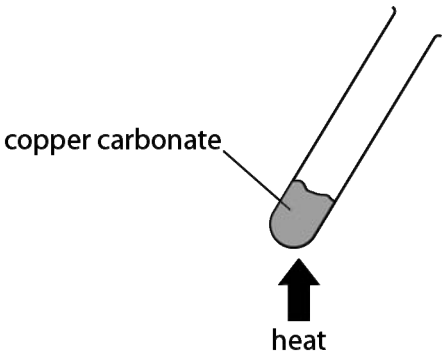
7 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.

$$CuCO_3 \rightarrow CuO + CO_2$$

Tim investigates this decomposition.

Look at the apparatus he uses.



Tim heats 1.24 g of copper carbonate in the test-tube.

He uses a yellow Bunsen flame for 1 minute.

(a) Tim finds he only gets an 80% yield of copper oxide.

Suggest why he did not get a 100% yield.

.....

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

(b) Tim repeats his experiment using 1.24g of copper carbonate.

He makes certain he gets a 100% yield.

This time he makes 0.80g of copper oxide.

What mass of **carbon dioxide** can Tim make by heating 0.62g of copper carbonate?

.....

.....

.....

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

(c) A factory manufactures copper oxide by heating copper carbonate.

The carbon dioxide made is a waste product.

(i) Look at the table of relative formula masses, M_r.

substance	relative formula mass, M_r
$CuCO_3$	
CuO	80
CO_2	44

The relative atomic mass for Cu is 64, for C is 12 and for O is 16.

Calculate the relative formula mass for copper carbonate.

Put your answer in the table.

.....

.....

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

(ii) Calculate the atom economy for the manufacture of copper oxide.

.....

.....

.....

.....

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

(iii) A factory wants as high an atom economy as possible when making a chemical.

Explain why.

.....

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

(iv) The factory uses a batch process rather than a continuous process.

What is the difference between a batch process and a continuous process?

.....

.....

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

[Total: 9]

8 Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

property	diamond	graphite
state at room temperature	solid	solid
appearance at room temperature	colourless, clear and lustrous	dull black
melting point		very high
hardness	very hard	soft and slippery
solubility in water	insoluble	insoluble
electrical conductivity		good conductor

(a) Complete the table by describing the

- melting point of diamond
- electrical conductivity of diamond. **[2]**

(b) Mark decides to use graphite electrodes in the electrolysis of sodium chloride solution.

Use information in the table and your own knowledge to give reasons for this decision.

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.....

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

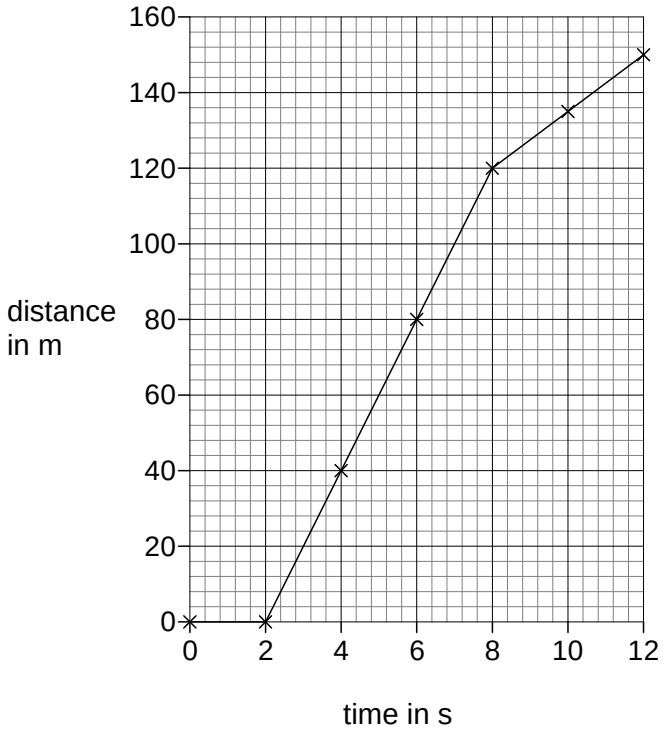
[Total: 4]

Section C – Module P3

9 This question is about motion and speed.

Brian drives 150m.

Look at the graph of Brian's journey.



(a) Describe what the graph shows about Brian's journey.

.....

.....

.....

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

(b) The speed limit is 13 m/s.

(i) An average speed camera took a photograph at 0 seconds and at 12 seconds.

Would the average speed camera have found Brian to be speeding? Use calculations to support your answer.

.....

.....

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

(ii) Did Brian break the speed limit at any point in his journey? Use evidence from the graph to support your answer.

.....

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

(c) Brian drove the same journey again at half the average speed.

How will this affect the time it takes for him to drive 150 m?

.....

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

[Total: 6]

10 (a) This question is about cars **accelerating**.

(i) Pat measures the speeds of two cars.

Both cars start from rest.

The diagram shows the speed changes of the cars after **3 seconds**.

car A

speed change of car A = 10 m/s

car B

speed change of car B = 15 m/s

Calculate the acceleration of **car A**.

.....

.....

.....

answer ..... units **[2]**

(ii) **Car B** has a greater acceleration.

Explain how you know this without calculating acceleration.

.....

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

(b) The driver of **car B** has to stop her car quickly.

The total distance the car travels before it stops is the **stopping distance**.

Name the two parts which make up the stopping distance and explain why it is important to know the stopping distance of a car.

.....

.....

.....

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

[Total: 5]

11 This question is about fuel consumption for a lorry.

(a) Look at the information about fuel consumption for this lorry in different driving conditions.

driving condition	windows of lorry	deflector fitted on lorry	fuel consumption in four tests in kilometres per litre	mean fuel consumption in kilometres per litre
A	closed	no	6.6, 6.8, 6.5, 6.5	6.6
B	closed	yes	7.6, 6.9, 7.0, 7.3	7.2
C	open	no	5.0, 6.0, 5.5, 5.9	5.6
D	open	yes	7.2, 7.0, 6.7, 6.7	

Calculate the **mean** fuel consumption for driving condition **D**.

Write your answer in the table.

.....

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

(b) Which driving condition gives the best fuel consumption?

Use the information in the table to explain why.

.....

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

(c) Car manufacturers are required to publish environmental and running cost data about the cars they manufacture. This is to help car buyers choose which car to buy.

car	fuel consumption in kilometres per litre	engine size (capacity) in cc	fuel costs in £ per 20 000 kilometres	CO_2 emissions in grams/kilometre	noise levels in dB
V	23.5	999	1103	122	73.0
W	20.4	1149	1273	138	72.4
X	18.2	1498	1428	158	72.0
Y	17.1	1598	1516	165	73.7
Z	16.7	1390	1559	172	70.0

Ronan and Anna want to buy a new car.

They want a car which provides the best balance between economic and environmental impact.

Ronan says 'We should buy car Z, because this car has the lowest fuel consumption and is the quietest model'. Anna realises that Ronan is wrong.

Use the data in the table to explain why Ronan is wrong. Which car should Anna and Ronan choose? Give the reasons for your choice.

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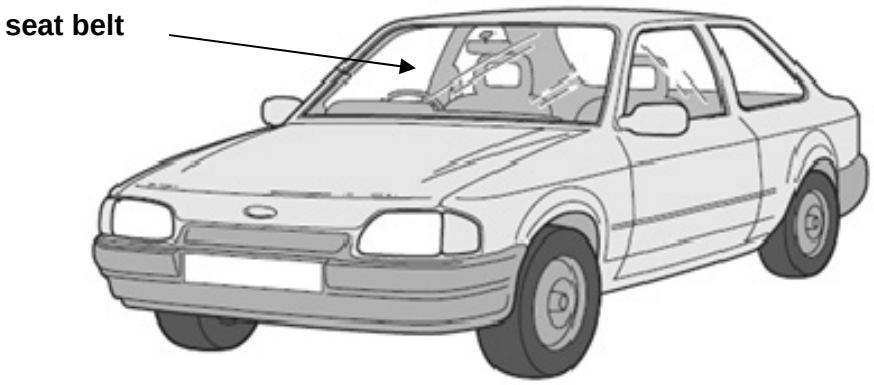
..... **[3]**

[Total: 5]

12 This question is about car safety.

Modern cars have **many** safety features.

Look at the diagram.



Some safety features **prevent** accidents and some **protect** the driver.

Seat belts are an important safety feature.

Explain how they work and why they have to be replaced after a crash.

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

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

[Total: 6]

13 Britney is a skydiver.

She jumps out of a plane.

(a) After 10 seconds, Britney is falling at a steady speed

What is the name of this steady speed?

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

(b) Explain how Britney reaches this steady speed.

.....

.....

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

[Total: 3]

Paper Total [75]

END OF QUESTION PAPER

PERIODIC TABLE

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 **A*l*** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C*l*** 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 **T*l*** 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.

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SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

ADDITIONAL SCIENCE B

B721/01

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

MARK SCHEME

Duration: 1 hours 15 minutes

MAXIMUM MARK 75

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)		right side pumps blood to lungs (1)	1	
	(b)		**any 2 from:** white blood cell kills microbes / engulfs microbes / makes antibodies (1) platelets causes blood to clot / prevents excessive bleeding (1) plasma transports food molecules, water, antibodies and waste products around the body (1)	2	**allow** specific names of cells eg lymphocyte **ignore** fights disease **allow** thrombocyte **ignore** forms a scab answer must reference transporting multiple substances to gain credit
	(c)		idea that haemoglobin carries oxygen (1) lack of oxygen for respiration / not enough oxygen to muscles / can't exercise (1)	2	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
2	(a)		respiration (1)	1	
	(b)	(i)	nucleus and mitochondria (1)	1	
		(ii)	because chromosomes are made of DNA (1) and chromosomes are too small to be seen with the microscope (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
3	(a)		bluecrop and toro / spartan and toro (1)	1	
	(b)		choose genetic engineering / ora (1) because cloned blueberries would be (genetically) identical to one of existing varieties / would not get new combination of characteristics / AW (1) but genetic engineering allows the wild taste gene to be inserted into the Spartan blueberry (1)	3	**answers must support method chosen to gain full credit** if cloning chosen **allow** 1 mark for reason why genetic engineering not chosen eg unexpected harmful effects
	(c)		maybe unexpected (harmful) effects / may escape into the wild / breed with wild plant (1)	1	**allow** expensive / technically difficult **ignore** time consuming **allow** unknown consequences **allow** ethical argument **allow** could be harmful / may be harmful **ignore** mutations
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
4	✎		**Level 3** Answer describes correctly the structural and genetic differences between sperm cells and body cells. The purpose of these adaptations is thoroughly explained. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Answer describes most of the structural differences between sperm cells and body cells with a limited explanation of their importance. The haploid nature may be stated but not fully explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer describes correctly one or two differences and gives a correct explanation for one of them. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include** differences: • many mitochondria in sperm compared to body cell • acrosome in sperm, not present in body cells • haploid nucleus in sperm, diploid nucleus in body cell **allow** small in size **allow** streamlined / aerodynamic (shape) explanation: • (mitochondria) for energy to swim • (acrosome) to produce enzymes / for digestion (of cell membrane) • (haploid nucleus) allows full or diploid number of chromosomes to be formed after fertilisation **allow** (enzymes) for digestion (of cell membrane)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
5	(a)		feels his pulse on wrist / neck (1) counts number of pulses in a certain time (1)	2	
	(b)	(i)	it increases (in a steady pattern) (1)	1	
		(ii)	correct answer from graph approx (50 km per hour) (1) line extrapolated on graph (1)	2	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
6	(a)		6 (minutes) (1)	1	**allow** range 6-6.4 minutes or 6 minutes-6 minutes 25 seconds
	(b)		hydrochloric acid runs out (1)	1	
	(c)		with 100 cm^3 of acid the volume of gas produced should be 125 cm^3 (1) the volume of gas produced will be greater than the volume of the gas syringe (1)	2	

Question			Expected answers	Marks	Additional guidance
6	(d)	✎	**Level 3** Answer applies understanding of the reacting particle model and rates of reaction to explain comprehensively two ways of increasing the rate of reaction. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Answer applies limited understanding of the reacting particle model and rates of reaction to explain partially two ways of increasing the rate of reaction or explain comprehensively one way of increasing the rate of reaction. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer gives two ways in which the rate of reaction can be increased. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • more collisions between zinc and acid particles results in faster reaction • increase the temperature of acid increases rate of reaction • increase the concentration of acid increases the rate of acid • increase the surface area of the zinc increases the rate of reaction **temperature of hydrochloric acid** • idea that acid particles move faster / acid particles have more energy / more successful collisions between acid and zinc particles / collisions between acid particles and zinc particles are more energetic • idea of increased collisions (frequency) between acid particles and zinc **concentration of hydrochloric acid** • idea of more crowded acid particles / more acid particles in the same volume / more H^+ ions in the same volume • idea of increased collisions (frequency) **ignore** reference to 'more particles' **powdered zinc** • idea of increased surface area of zinc / more zinc particles exposed to the acid • idea of increased collisions (frequency) between zinc and acid particles

Question			Expected answers	Marks	Additional guidance
6	(e)		slow reaction – rusting / corrosion (1) fast reaction – any explosion (1)	2	**allow** other very slow reactions **allow** reactions of alkali metals with water
			Total	**12**	

Question			Expected answers	Marks	Additional guidance
7	(a)		not all copper carbonate decomposes because not heated for long enough / not all copper carbonate decomposes because the temperature was not high enough (1)	1	
	(b)		0.22 g (1) **OR** idea that carbon dioxide made from 1.24g is 0.44g (1)	2	**allow** full marks for 0.22g with no working, correct working for 1 mark **allow** use of molecular masses and moles to calculate eg 0.62/124 = 0.005 moles (1)
	(c)	(i)	124 (1)	1	**allow** 123.5
		(ii)	64.51% (2) **OR** If correct answer not given **atom economy =** $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}}$ **× 100** **atom economy =** $\frac{80}{124}$ **× 100 (1)**	2	**allow** full marks for the correct answer even if the equation for atom economy is not stated **allow** 65 / 64.5 / up to the calculator value **allow** ecf/ 64.8% if answer given for (i) is 123.5
		(iii)	because fewer atoms lost as waste so it is a greener process / because fewer atoms lost as waste so it is a more sustainable process (1)	1	
		(iv)	continuous – chemicals made all the time / chemicals made 24/7 (1) whereas in batch – chemicals made on demand (and not all the time) (1)	2	
			Total	**9**	

Question			Expected answers	Marks	Additional guidance
8	(a)		very high (1) does not conduct (1)	2	
	(b)		graphite is a good electrical conductor so will be able to transfer the electrical current without loss (from the wires to the electrolyte) (1) graphite has a high melting point / solid / insoluble / inert so will not dissolve / melt / react during electrolysis (mixing with the electrolyte) (1)	2	**allow** higher level answers relating to the structure of graphite eg delocalised electrons allow current to flow (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
9	(a)		straight horizontal line / between 0 and 2 seconds shows: zero speed / not moving / stationary (1) straight line gradient / between 2 and 8 seconds shows: steady speed (1) less steep gradient / between 8 and 12 seconds shows: slower steady speed / ora (1)	3	**allow** standing still (1) **allow** Brian does not move for 2 seconds, then drives fast for 6 seconds, and drives slower for 4 seconds. (2) as no reference to steady speed
	(b)	(i)	no because average speed is 12.5 m/s (1)	1	**mark is for evidence of calculation to support answer**, not simply for stating 'no'
		(ii)	yes (no mark) because he was stationary for some of the time so for other times he was going faster than his average speed / idea that gradient changed so at some points in journey he was going faster than the average speed (1)	1	**allow** higher level answers above target grade where speed is calculated for part of the journey
	(c)		the time taken to travel the journey will be double (1)	1	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
10	(a)	(i)	3.33 or 3 1/3 (1) m/s^2 (1)	2	**ignore** more than 2 decimal places **allow** 3.3
		(ii)	idea of greater speed change (in same time / 3 seconds) (1)	1	
	(b)		thinking distance + braking distance (1) to know how much distance to leave between cars/to avoid a crash when braking (1)	2	**allow** description of the two distances (eg thinking distance = distance travelled whilst reacting/before putting brakes on) but **both** needed (1) **allow** for road safety (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
11	(a)		6.9 (kilometres per litre) (1)	1	**allow** answer in table or on answer line
	(b)		driving condition **B** gives the best fuel consumption because it has the best shape / is more aerodynamic/is streamlined (1)	1	**allow** driving condition **B** gives the best fuel consumption as windows closed and deflector fitted (1)
	(c)		Ronan has got fuel consumption back to front – more km per litre is better / AW (1) **no mark for choice of car, marks are for valid reasons** most economical / lowest economic impact is vehicle **V** OR best fuel consumption / lowest cost for fuel is car **V** (1) environmental impact is a choice between **Z** quietest and **V** lowest CO_2 emissions (1)	3	**allow** idea that car **Z** will go the shortest distance on a set amount of fuel (1) **answers must support choice of car to gain credit**
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
12	✎		**Level 3** Detailed explanation of reasons for fitting seat belts and replacing them after crashes including application of energy and detail of damage to seat belts. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Limited explanation of reasons for fitting seatbelts and replacing them after crashes including some reference to the type of damage to the seat belt. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** An attempted explanation of reasons for fitting seatbelts and replacing them after crashes; references do not go beyond the idea of protecting the driver OR that the seat belt is damaged. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **how seat belts work** • seat belts are intended to protect all the passengers wearing them in the event of an accident • by absorbing energy when vehicles stop • by reducing the force on the wearer • because the momentum change is spread over a longer time • reducing injuries for wearers **accept** examples of how seat belts protect, eg seat belts keep you in your seat / stop you hitting the windscreen **why they have to be replaced** • seat belts are damaged in a crash • as energy is absorbed seatbelt (deforms) changes in shape • some damage to seat belts is irreversible • idea of 'one time use' / repeated damage could cause seatbelt to break / seatbelt won't be as strong after an accident • damage to anchor points, belt locking mechanism etc • damage may not be easily visible, so replace to minimise future risk **accept** examples of specific damage eg seat belts lock in a crash **accept higher level answers** eg seat belts spread the stopping force across ribs and pelvis / stronger parts of body seat belt webbing is a flexible material
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
13	(a)		terminal (speed) (1)	1	**allow** terminal (velocity)
	(b)		initially Britney's speed increases and frictional forces increase with speed (1) when the forces are balanced, her speed is steady / does not change (1)	2	**allow** answers in terms of acceleration **allow** alternative terms for frictional forces (drag, friction, air resistance) for second marking point candidates must link balanced forces to steady speed **ignore** up thrust
			Total	**3**	

Assessment Objectives (AO) Grid
(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1			**1**
1(b)	2			**2**
1(c)		2		**2**
2(a)	1			**1**
2(b)(i)		1		**1**
2(b)(ii)		1	1	**2**
3(a)		1		**1**
3(b)		2	1	**3**
3(c)	1			**1**
4✎	6			**6**
5(a)	2			**2**
5(b)(i)		1		**1**
5(b)(ii)		2		**2**
6(a)		1		**1**
6(b)		1		**1**
6(c)		2		**2**
6(d) ✎	2	4		**6**
6(e)	2			**2**
7(a)	1			**1**
7(b)		2		**2**
7(c)(i)		1		**1**
7(c)(ii)	1	1		**2**
7(c)(iii)	1			**1**
7(c)(iv)	2			**2**
8(a)	2			**2**
8(b)			2	**2**
9(a)	1	2		3
9(b)(i)		1		1
9(b)(ii)		1		1
9(c)		1		1
10(a)(i)	1	1		2
10(a)(ii)		1		1
10(b)	2			2
11(a)		1		1
11(b)		1		1
11(c)		1	2	3
12 ✎	5	1		6
13(a)	1			1
13(b)	2			2
Totals	**36**	**33**	**6**	**75**

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