

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
 TWENTY FIRST CENTURY SCIENCE  
 SCIENCE A**

UNIT 1: Modules B1 C1 P1 (Higher Tier)

**SAMPLE ASSESSMENT MATERIAL**

**(from 2010 onwards)**

Time: 40 minutes

Candidates answer on the question paper

**Additional materials (enclosed):**

None

Calculators may be used.

**Additional materials:** Pencil  
 Ruler (cm/mm)

Candidate  
 Forename

Candidate  
 Surname

Centre  
 Number

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Candidate  
 Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your name 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 you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- 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 **42**.

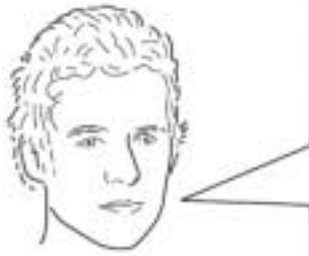
FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	5	
2	9	
3	9	
4	6	
5	6	
6	7	
<b>TOTAL</b>	<b>42</b>	

This document consists of **16** printed pages.

Answer **all** questions.

- 1 Sam has been watching a TV programme on continental drift.

He is trying to explain it to his friend Jo, but he has forgotten some of the information in the programme.



**Sam**

The crust of the Earth is made of tectonic plates which all fit together. The mantle is liquid. The plates are on top of the mantle.

The tectonic plates move about. At their edges, plates collide, or move apart, or scrape past each other. Volcanoes and earthquakes happen at edges where tectonic plates meet, but mountains build up near the centre of the plates. Where plates move apart under the oceans, they make new seafloor.

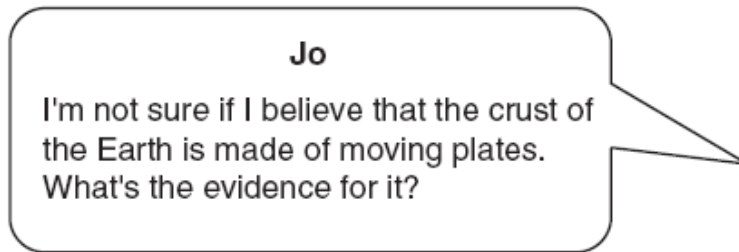
- (a) Sam makes a number of statements of fact. Some of them are mistakes.

Write **T** in the box next to each **true** statement and **F** in the box next to each **false** one.

	T (true) or F (false)
The crust of the earth is made of tectonic plates.	<input type="checkbox"/>
The mantle is liquid.	<input type="checkbox"/>
The plates are on top of the mantle.	<input type="checkbox"/>
The tectonic plates move about.	<input type="checkbox"/>
Volcanoes and earthquakes happen where tectonic plates meet.	<input type="checkbox"/>
Mountains build up near the centre of the plates.	<input type="checkbox"/>

[4]

(b) Jo needs to be convinced of these ideas.



Here are some scientific observations.

Put a tick (✓) in the box next to **each** statement which provides evidence for continental drift.

The Earth has a hot core of molten iron.

Rocks of the ocean floor are magnetised by the Earth's field.

There are ridges of solidified magma near the centres of many oceans.

Volcanoes and earthquakes are common in coasts and islands along the edges of the Pacific Ocean.

[1]

[Total: 5]

- 2 When astronomers look at the night sky through telescopes, they see many stars and spiral nebulae.



© R. Jay GaBany

In 1920, astronomers did not know what 'spiral nebulae' were, nor how far away they were. There was a great debate between two astronomers.



#### Harlow Shapley

Our Milky Way is the only galaxy there is: it's the whole Universe. It is huge: 300 000 light years across.

Spiral nebulae are clouds of gas and dust inside the Milky Way.

Our Sun is far from the centre of the Milky Way.

#### Heber Curtis

You're wrong about the size of the Milky Way - it's ten times smaller than that.

Our Sun is very near the centre of the Milky Way.

These spiral nebulae are galaxies just like our Milky Way. They are much further away from us than the edge of the Milky Way galaxy.



- (a) Explain why Shapley and Curtis had different explanations, even though they used the same experimental data.

Your answer should include

- differences between their explanations
- suggested reasons for their disagreement.

.....

.....

.....

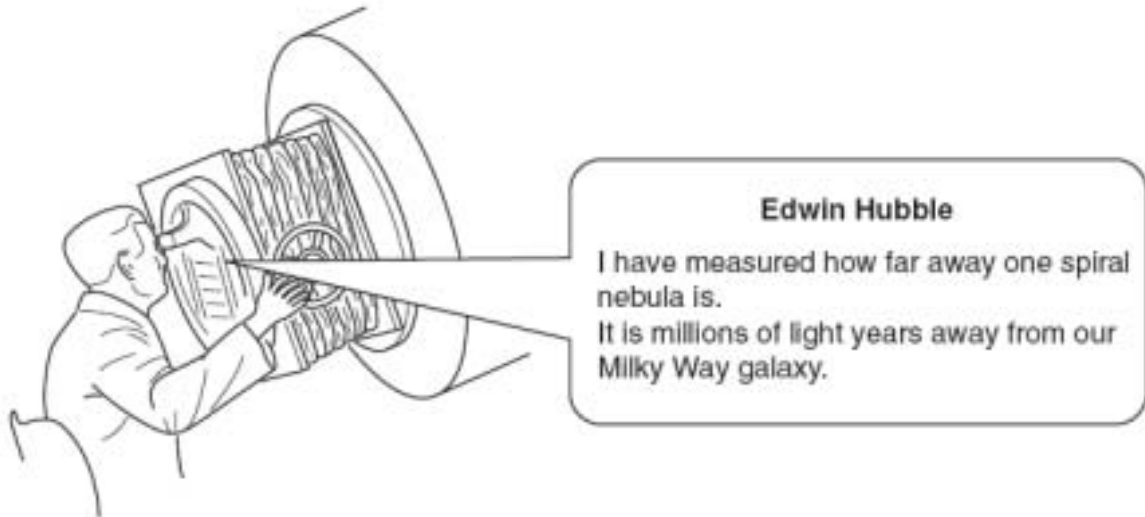
.....

.....

.....

..... [4]

- (b) Another astronomer made more accurate measurements on stars and spiral nebulae.



Hubble's measurements helped to solve part of the debate between Shapley and Curtis.

Put a tick (✓) or a cross (✗) in each box to show whether Hubble's observation supported Shapley's theory or Curtis's theory.

Key:

- ✓ – supports theory
- ✗ – does **not** support theory

the size of the Milky Way

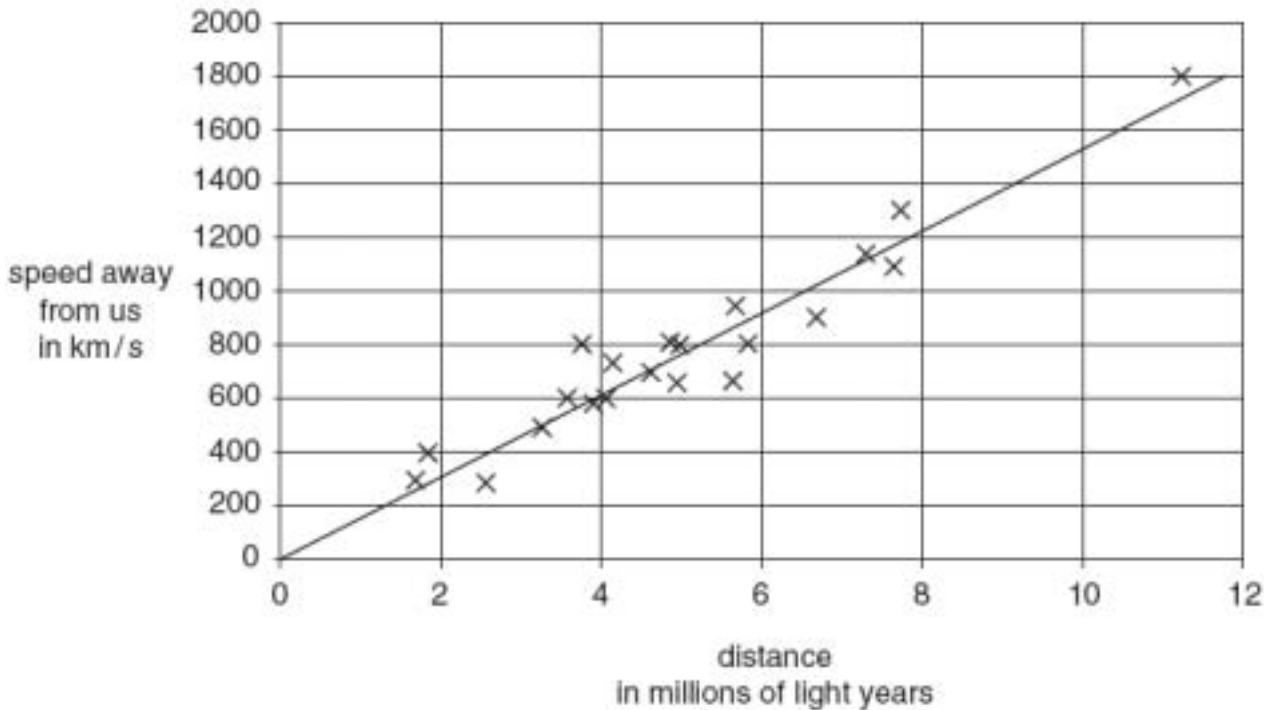
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where spiral nebulae are found

--	--

[2]

- (c) Edwin Hubble made many more measurements of spiral nebulae. He measured their speeds and the distances to them. Here is a graph of his data.



Put a tick (✓) in the box next to **each** correct statement supported by this graph.

All the spiral nebulae in this graph are moving away from us.

A spiral nebula eight million light years away from us has exactly twice the speed of one which is four million light years away from us.

The graph supports the theory that Space is expanding.

The increase in speed of a more distant spiral nebula is caused by its greater distance from us.

There are no spiral nebulae further from us than 12 million light years.

There is a correlation between speed and distance.

[3]

[Total: 9]

3 Read the newspaper article below.

### Three sisters unite for surrogate birth

Laura, who is infertile, has a baby boy thanks to her two sisters.

Her sister Rebecca had an operation to remove an egg.

This was fertilised using sperm from Laura's husband, Simon.

The embryo was implanted into another of Laura's sisters, Hannah.

Hannah became pregnant and gave birth to a healthy boy, Jake.

The treatment cost £3000 and had only a 25% chance of success.

(a) Jake is a boy. His sex is determined by his sex chromosomes.

Write down the sex chromosomes Jake must have inherited.

answer ..... [1]

(b) Which statement best explains who Jake is most like?

Put a tick (✓) in the correct box.

Rebecca, because she donated the egg.

Hannah, because she was pregnant with Jake for 9 months.

Rebecca, because all of Jake's genes came from her.

Hannah, because half of Jake's genes came from her.

[1]

(c) (i) The treatment described in the newspaper article is carried out only very rarely.

One way of deciding whether or not to take part in such a treatment would be to balance the benefits against the costs.

For each of the three sisters, **suggest** a potential benefit **and** a potential cost.

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

(ii) Treatments such as the one described are supported by some people and opposed by others.

Suggest ethical arguments **for** and **against** this treatment.

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



(d) Laura and Rebecca are identical twins.

Draw a straight line from each **statement** to its best **explanation**.

statement	explanation
Rebecca and Laura are clones.	They both grew from stem cells.
	Mutations occur during development due to environmental factors.
	No two sperm are ever exactly the same.
	Sexual reproduction produces new variations.
Rebecca and Laura will not have exactly the same DNA.	Two eggs were released and fertilised with sperm from the same father.
	During its development, an embryo split into two groups of cells.
	No two eggs are ever exactly the same.

[2]

[Total: 9]

4 Read the article below.

**Blood, Bones and Stem Cells**

Mesenchymal stem cells can be extracted in large numbers from bone marrow and have the ability to grow into bone, cartilage, muscle and fat.

These adult stem cells from the bone marrow of patients may be used in the future to help mend broken bones.

Mesenchymal stem cells will be taken from the patient, grown and using genetic techniques directed into producing bone and cartilage. This new bone and cartilage will help repair bone defects such as osteoporosis and fractures.

(a) Choose from this list of words to answer the questions below.

**conclusion**

**fact**

**prediction**

**theory**

(i) Which term **best** describes the **first** sentence in the article?

answer ..... [1]

(ii) Which term **best** describes the **second** sentence in the article?

answer ..... [1]

(b) The use of mesenchymal stem cells described in the article is different from treatment based on cloning embryonic stem cells.

Put ticks (✓) in the boxes next to the **two** statements which **best** describe these differences.

It is legal.

There is no nuclear replacement.

The stem cells are from the patient.

Mesenchymal stem cells are already specialised.

Only the nucleus used comes from the patient's cells.

Adult stem cells can grow into any type of specialised cell.

[2]

(c) Stem cells can also be obtained from embryos (embryonic stem cells).

Embryonic stem cell research is controversial.

Read these statements about the use of embryos in stem cell research.

- 1 Embryos are living human beings.
- 2 Embryos younger than 14 days have no nervous system.
- 3 Human beings have rights.
- 4 In normal pregnancies, many embryos die at an early stage of development.
- 5 Millions of people with incurable diseases could benefit from stem cell research.
- 6 The embryos used in stem cell research are left over from fertility treatments and would die.

(i) Which **two** statements, taken together, support the argument that the use of embryos is ethically wrong?

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

(ii) Which **three** statements, taken together, support the argument that the use of embryos is justified, because it may lead to the best outcome for the majority of people involved?

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

**[Total: 6]**

- 5 In the UK, older cars must have an MOT test every year to check that they are working properly.

One part of the test is to check that the amount of each pollutant gas in the exhaust emissions is within legal limits when the engine is running at a particular speed.

Exhaust emissions contain carbon monoxide, sulphur dioxide and nitrogen oxides.

- (a) The molecules of these gases are formed in the engine.

Where have the atoms come from which produce these gases?

Put a tick (✓) in the correct box for each gas.

gas	atoms in the fuel alone	atoms in the air alone	atoms in both the fuel and the air
carbon monoxide			
sulfur dioxide			
nitrogen oxides			

[2]

- (b) Liz uses an electronic sensor to take five measurements of the percentage of carbon monoxide in the car exhaust.

These are her results.

test	percentage of carbon monoxide (%)
1	0.12
2	0.03
3	0.04
4	0.03
5	0.02

- (i) Liz treats test 1 as an **outlier**.

Why does she do this?

Put a tick (✓) in the box next to the **best** answer.

The first test is just a rough trial.

This result is higher than the mean of the other results.

This result lies well outside the range of the other results.

This result is not a best estimate.

[1]

(ii) Complete the sentence about the true value of the percentage of carbon monoxide.

The true value lies in the range ..... [1]

(iii) Why does Liz repeat the test five times?

Put ticks (✓) in the **two** boxes next to true reasons for repeating the test.

She is looking for a correlation.

The electronic sensor may not work reliably.

The data is more accurate.

It is important to control other factors when measuring.

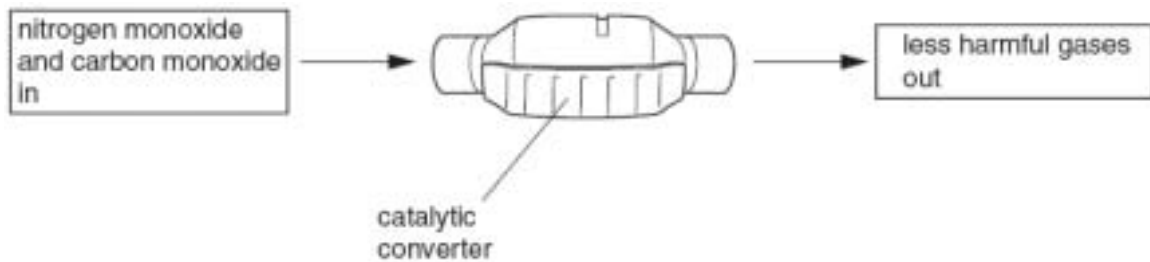
The percentage of carbon monoxide in the exhaust may vary.

[2]

[Total: 6]

6 Nitrogen monoxide and carbon monoxide are gases that affect air quality.

Catalytic converters reduce the emission of these gases from cars.



(a) Complete the sentences to explain how the catalytic converter works.

Choose from this list.

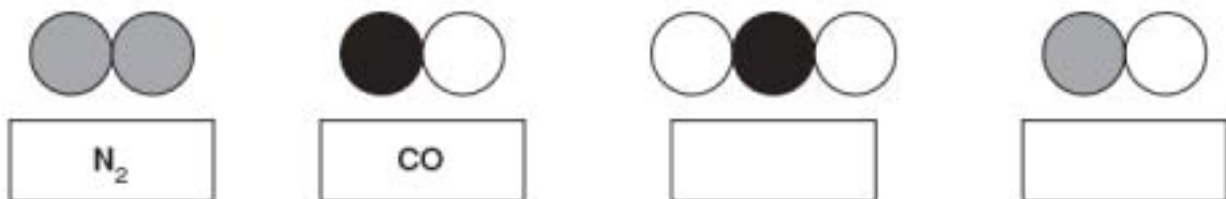
- carbon
- carbon dioxide
- hydrocarbon
- nitrogen
- nitrogen monoxide
- sulfur dioxide

In the converter, carbon monoxide is converted into carbon dioxide by reacting with molecules of .....

The products of this reaction are carbon dioxide and ..... [2]

(b) The diagrams show some of these molecules.

Write the missing formulae in the boxes.



[2]



**PLEASE DO NOT WRITE ON THIS PAGE**

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Acknowledgements:

Q.2 photo © R. Jay GaBany, [www.cosmotography.com](http://www.cosmotography.com). Reproduced by kind permission of R. Jay GaBany.

Q.4 Article adapted from *Watchdog* backs more embryo checks, 10 May 2006, © BBC News, <http://news.bbc.co.uk>

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GCSE Unit

MARK SCHEME

SAMPLE ASSESSMENT MATERIAL  
(from 2010 onwards)

**Science A (J630)**  
**Modules B1, C1 and P1**  
**Higher Tier**

**A211/02**

Maximum Mark: 42

## 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, e.g. 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
<b>not/reject</b>	= answers which are not worthy of credit
<b>ignore</b>	= statements which are irrelevant - applies to neutral answers
<b>allow/accept</b>	= 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

E.g. 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.
7. The list principle:  
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, e.g. one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

8. Marking method for tick boxes:

Always check the additional guidance.

If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.

If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses.

Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

E.g. If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	x	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	x		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

Question		Expected Answers	Marks	Rationale
1	a	<p>made of tectonic plates <input type="checkbox"/></p> <p>mantle is liquid <input type="checkbox"/></p> <p>plates are on top of the mantle <input type="checkbox"/></p> <p>tectonic plates move about <input type="checkbox"/></p> <p>volcanoes and earthquakes <input type="checkbox"/></p> <p>mountains build up <input type="checkbox"/></p>	4	<p>6 correct (4)</p> <p>5 correct (3)</p> <p>4 correct (2)</p> <p>3 correct (1)</p> <p>Note 1 or 2 correct = 0</p> <p>T or F must be clearly a T or an F rather than a combination or one overwritten on the other without clear decision. If overwrite is clearly bolder then accept.</p>
	b	<p><input type="checkbox"/></p> <p><input type="checkbox"/></p> <p>ridges of solidified magma <input checked="" type="checkbox"/></p> <p>volcanoes and earthquakes <input checked="" type="checkbox"/></p>	1	<p><b>both</b> correct for one mark</p> <p>accept any clear indication of choice.</p>
<b>Total</b>			<b>5</b>	

Question		Expected Answers	Marks	Rationale				
2	a	<p><i>Differences –</i>            number of galaxies;            size of the Milky Way;            position of the Sun within Milky Way;            position of Super Nova;            what Super Nova are;  <i>Suggested reasons –</i>            explanations require imagination/cannot just be deduced from evidence;            scientists judgements can be affected by personality/experience/background/interests;            evidence too poor to decide between the two explanations;            any other sensible suggestion</p>	4	<p>maximum 3 marks for differences</p> <p>Maximum 3 marks for suggested reasons</p>				
	b	<p>supports Shapley    supports Curtis</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">x</td> </tr> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">✓</td> </tr> </table>	x	x	x	✓	2	<p>one mark for each correct row            Blank = X            But if a mixture of X and blank boxes then blank = No Response</p>
x	x							
x	✓							
	c	<p>spiral nebulae are moving away <input checked="" type="checkbox"/></p> <p>theory that space is expanding <input checked="" type="checkbox"/></p> <p>there is a correlation <input checked="" type="checkbox"/></p>	3	<p>One mark for each correct ✓            See guidance 8 regarding marking for tick boxes</p>				
		<b>Total</b>	<b>9</b>					

Question		Expected Answers	Marks	Rationale				
3	a	XY / X and Y	1	either order <b>Not</b> X or Y				
	b	because she donated the egg <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>✓</td></tr><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>	✓				1	No extra ticks allowed.
✓								
	c	i	3	<p>Laura has a (genetically related) baby <b>and</b> may damage her relationship to her sisters/may be difficult to explain to Jake when he grows up;</p> <p>Rebecca help/make sister happy/will become an aunt <b>and</b> risk of operation/removal of eggs</p> <p>Hannah help/make sister happy/will become an aunt <b>and</b> taking a risk during pregnancy and birth/may find it difficult to give away Jake</p> <p>accept other sensible suggestions</p>				

Question			Expected Answers	Marks	Rationale
3	c	ii	<p><i>Against –</i>            playing God/            unnatural in itself/            against religious belief/            expensive/money could be better spent on other treatments/            only a 1 in 4 chance of success/            any other sensible suggestion (1);</p> <p><i>For –</i>            Greater good of greater number/            Helps someone &amp; hurts no-one/            People have free will to choose this course of action/            any other sensible suggestion (1);</p>	2	1 mark 'for' 1 mark 'against'

Question		Expected Answers	Marks	Rationale
3	d		2	one mark for each correct link if either left-hand box has more than one link, ignore that box
<b>Total</b>			<b>9</b>	



Question			Expected Answers	Marks	Rationale						
4	a	i	fact (1)	1							
		ii	prediction (1)	1							
	b		no nuclear replacement stem cells are from the patient <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td> </td></tr> <tr><td>✓</td></tr> <tr><td>✓</td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table>		✓	✓				2	One mark for each correct ✓ See guidance 8 regarding marking for tick boxes
✓											
✓											
	c	i	1 and 3 (1)	1	Either order						
		ii	2, 5 and 6 (1)	1	Any order						
			<b>Total</b>	<b>6</b>							

Question		Expected Answers			Marks	Rationale	
5	a		in fuel	in air	in both	2	Mark each row separately, more than 1 tick in the row = 0 for that row. 3 correct rows (2) 2 or 1 correct row(s)(1)
		carbon monoxide			✓		
		sulphur dioxide			✓		
		nitrogen oxides		✓			
	b	i	lies well outside the range			1	No extra ticks allowed.
<input type="checkbox"/>							
<input checked="" type="checkbox"/>							
		ii	0.02 to 0.04 / 0.02 – 0.04 / 0.02, 0.04 / 0.04 to 0.02 / 0.04 – 0.02/ 0.04, 0.02 (1)			1	<b>Both</b> correct for one mark. Check decimal point: 0.2 to 0.4 is wrong.
		iii	sensor may not work reliably			2	If 4 or 5 boxes are ticked, award no marks. If 3 boxes are ticked, deduct 1 mark from the score One mark for each correct choice
			<input checked="" type="checkbox"/>				
			carbon monoxide may vary				
			<input checked="" type="checkbox"/>				
<b>Total</b>					<b>6</b>		

Question		Expected Answers	Marks	Rationale
6	a	nitrogen monoxide/ NO (1) nitrogen/ N/N <sub>2</sub> (1)	2	Must be in correct order. Formula must be capital letters e.g. N 2 should be subscript e.g. N <sub>2</sub> not N2
	b	<div style="display: inline-block; border: 1px solid black; padding: 2px 10px; margin: 5px;">CO<sub>2</sub></div> <div style="display: inline-block; border: 1px solid black; padding: 2px 10px; margin: 5px 20px;">NO</div>	2	One mark for CO <sub>2</sub> and one for NO Formula must be capital letters e.g. N 2 should be subscript e.g. CO <sub>2</sub> not CO2 or CO <sup>2</sup>
	c	<p>[3 marks] Candidate demonstrates a high level of understanding of the mechanism by which NO<sub>x</sub> is produced by hydrocarbon combustion in vehicle engines. Relevant additional data is identified and linked to the scientific explanation to indicate how the data would support the suggested correlation. The answer is expressed clearly and logically.</p> <p>[2 marks] Candidate demonstrates a basic understanding that NO<sub>x</sub> is produced by fuel combustion in vehicles. Relevant additional information that would support the rush-hour traffic NO<sub>x</sub> link is identified, although not linked to the science explanation of the suggested correlation. The answer is expressed clearly and logically.</p> <p>[1 mark] Candidate identifies relevant additional information that would support the rush-hour traffic NO<sub>x</sub> link, but fails to provide a scientific explanation for the correlation.</p>	3	<p><i>Data –</i> Traffic information; NO<sub>x</sub> data for more days;</p> <p><i>Scientific explanation –</i> Link NO<sub>x</sub> to fuel combustion in cars; Any detail of N → NO → NO<sub>2</sub>;</p>
<b>Total</b>			<b>7</b>	
<b>Paper Total</b>			<b>42</b>	