

**Science A**

General Certificate of Secondary Education

Unit **A141/02**: Unit 1: Modules B1, C1, P1 (Higher Tier)

**Mark Scheme for January 2013**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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**Subject-specific Marking Instructions**

- a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).
- b. 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.

*e.g. for a one-mark question where ticks in the third and fourth boxes are required for the mark:*

✘
✘

*This would be worth  
1 mark.*

✓
✘

*This would be worth  
0 marks.*

✘
✘
✓
✓

*This would be worth  
1 mark.*

- c. 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.

## d. Marking method for tick-box questions:

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 and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. 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 cities in England:

Edinburgh	<input type="checkbox"/>
Manchester	<input type="checkbox"/>
Paris	<input type="checkbox"/>
Southampton	<input type="checkbox"/>

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		✓		✓	✓		✓	
<b>Score:</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>NR</b>

## e. For answers marked by levels of response:

i. **Read through the whole answer from start to finish**

ii. **Decide the level that best fits** the answer – match the quality of the answer to the closest level descriptor

iii. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

iv. Use the **L1**, **L2**, **L3** annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6-mark extended writing questions include:

- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

Question		Answer	Marks	Guidance
1	(a)	alleles heterozygous recessive	2	all three correct = 2 marks 2 correct = 1 mark
	(b)	E and F have affected and unaffected offspring (1);  H doesn't have the condition so cannot have the allele (1); E and F must be heterozygous/ have both alleles (because both have the condition) (1); recognises that it is not sex-linked (1);  it must be caused by a dominant allele (1); all of their offspring would be affected if the condition were recessive (1)	3	<b>any three points</b> i.e. some children of E & F have it and some don't – ignore any probabilities such as 50% for this marking point <b>accept</b> gene for allele  May be shown in Punnett square  <b>ignore</b> 'carrier' used in case of passing on dominant allele <b>accept</b> H must have two recessive alleles <b>accept</b> correct calculation of 75% affected / 25% not affected for this last marking point
<b>Total</b>			<b>5</b>	

Question		Answer	Marks	Guidance
2	(a)	D F E (A) C G B (2)	2	DFE gets (1); ('Don't Forget Eggs') CGB gets (1) ('Can't Get Better')
	(b)	<p><b>Level 3 (5–6 marks)</b> Identify at least two distinct implications and at least two concerns, which are clearly linked. Answer must relate to the case of saviour siblings which may be implied.</p> <p>Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b> Identify at least two implications and at least two concerns, which are not necessarily linked. Answer must relate to the case of saviour siblings, which may be implied.</p> <p>Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Identifies at least two implications or concerns (or one of each, not necessarily linked). May not refer to saviour siblings.</p> <p>Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to A/A*</b> <b>Indicative scientific points about implications may include:</b></p> <ul style="list-style-type: none"> <li>• saves the life of the daughter</li> <li>• no blood transfusions</li> <li>• fewer stays in hospital / infections</li> <li>• less stress for the family.</li> <li>• Government needs to decide what is and isn't allowed with regards to embryo selection.</li> <li>• false positives or negatives</li> <li>• medical intervention on saviour sibling</li> <li>• unused embryos are discarded</li> </ul> <p><b>Indicative scientific points about concerns may include:</b></p> <ul style="list-style-type: none"> <li>• child only born to be a saviour sibling</li> <li>• would not have been chosen otherwise</li> <li>• is it right to select embryos for their characteristics (even if they have the potential to save other lives)</li> <li>• discarding of other embryos is unethical</li> <li>• some people don't like the idea of 'playing God'</li> <li>• could cause the brother stress in the future / low self-esteem</li> <li>• brother too young to be involved in the decision to use his stem cells.</li> <li>• expensive</li> <li>• general idea of medical procedures carrying risk or distress to mother or saviour sibling</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
<b>Total</b>			<b>8</b>	

Question		Answer	Marks	Guidance					
3	(a)	individuals that have identical genes (1)	1						
	(b)	bulbs/runners (1)	1	<b>allow</b> tubers/stolons/corms/rhizomes/asexual (reproduction)					
	(c) (i)	most plants lying around the average/middle (1); few outside central range/being short or tall (1); quantitative reference to data from table (1)	2	<b>any two points accept any wording</b> i.e. there is a fixed range 'height increases and then decreases' get both points 1 & 2. i.e. refers to range 20.0 – 21.9 or 18 – 23.9 e.g. 'most are between 20 and 21.9' gets points 1 and 3. allow 2 marks for 'It's a normal distribution/bell curve'					
	(ii)	Karen does not know the heights... <div style="display: inline-block; vertical-align: middle;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td style="width: 20px; height: 15px;"></td></tr> <tr><td style="width: 20px; height: 15px;"></td></tr> <tr><td style="width: 20px; height: 15px;"></td></tr> <tr><td style="width: 20px; height: 15px;"></td></tr> <tr><td style="width: 20px; height: 15px;">✓</td></tr> </table> </div>					✓	1	
✓									
	(iii)	<i>William is correct because:</i> clones can vary in height due to environmental factors (1); example of an environmental factor, e.g. nutrients, water, light, carbon dioxide etc. (1); heights are all similar (1)	2	this mark is independent of the first mark  do not award 2 marks unless William has clearly been chosen.					
<b>Total</b>			<b>7</b>						



Question		Answer	Marks	Guidance								
4	(a)		2	LHS correct = 1 mark any line from 3 <sup>rd</sup> box on LHS = 0 mark for LHS <b>reject</b> LHS if more than 3 lines drawn.  RHS correct = 1 mark any line to bottom box on RHS = 0 mark for RHS <b>reject</b> RHS if more than 3 lines drawn.								
	(b) (i)	nitrogen and oxygen atoms from the air (1); react at the high temperatures of the engine (1)	2	must imply both gases come from the air <b>allow</b> 'heat' for 'high temperature'								
	(ii)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="height: 15px;"> </td><td style="width: 20px;"> </td></tr> <tr><td style="height: 15px;"> </td><td> </td></tr> <tr><td style="height: 15px;"> </td><td> </td></tr> <tr><td style="height: 15px;">All new cars have catalytic converters fitted.</td><td style="text-align: center;">✓</td></tr> </table>							All new cars have catalytic converters fitted.	✓	1	
All new cars have catalytic converters fitted.	✓											
<b>Total</b>			<b>5</b>									

Question			Answer	Marks	Guidance										
5	(a)	(i)	<table border="1"> <thead> <tr> <th>true</th> <th>false</th> </tr> </thead> <tbody> <tr> <td></td> <td>✓</td> </tr> <tr> <td></td> <td>✓</td> </tr> <tr> <td></td> <td>✓</td> </tr> <tr> <td>✓</td> <td></td> </tr> </tbody> </table>	true	false		✓		✓		✓	✓		2	all 4 correct = 2 marks 3 correct = 1 mark 2 or fewer correct = 0 marks
true	false														
	✓														
	✓														
	✓														
✓															
		(ii)	both fuels produce CO <sub>2</sub> (as a pollutant) (1);  CO <sub>2</sub> produced by biofuels is taken in by plants (at the same rate) (1)	2	<b>ignore</b> reference to NO <sub>x</sub> CO or particulate carbon. <b>accept</b> 'biofuels produce less CO <sub>2</sub> '  for this mark, look for the recognition that the biofuel plants are recycling the CO <sub>2</sub> by photosynthesis. award this mark for clear reference to biofuel being carbon neutral.										
		(iii)	it will help as air pollution is less than with petrol cars (1); but air pollution still increases (1)	2	a comparison between biofuel and petrol must be stated or implied for the first mark. 'air pollution increases, but at a lower rate' would get both marks.  air pollution goes down = 0										
	(b)		<table border="1"> <tbody> <tr> <td></td> <td></td> </tr> <tr> <td>Very large areas of land are needed to grow biofuels.</td> <td>✓</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td>Less land will be available to grow food crops</td> <td>✓</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>			Very large areas of land are needed to grow biofuels.	✓			Less land will be available to grow food crops	✓			1	both ticks required for 1 mark ticks in any other boxes = 0
Very large areas of land are needed to grow biofuels.	✓														
Less land will be available to grow food crops	✓														
<b>Total</b>				<b>7</b>											

Question		Answer	Marks	Guidance
6	(a)	$100 - (48 + 2 + 47.5) = 2.5$ (1); (1)	2	correct answer without working = 2 marks answer may appear in the table
	(b)	<p><b>Level 3 (5–6 marks)</b></p> <p>Correct changes in levels of carbon dioxide, oxygen and water vapour and at least two different appropriate processes given. Specialist terms correctly used (photosynthesis, dissolving, absorption, condensation, sedimentary), even if not correctly spelled.</p> <p>Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b></p> <p>Correct process(es) given with correct change(s) of associated gas(es)</p> <p>Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b></p> <p>Correct changes of two gases described with no process for change given. May confuse with changes caused by recent burning of fossil fuels.</p> <p>Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b></p> <p>Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to C.</b></p> <p><b>Indicative scientific points about the process may include:</b></p> <ul style="list-style-type: none"> <li>• Carbon dioxide decreased because green plants photosynthesised</li> <li>• Carbon dioxide decreased because it dissolved in the oceans</li> <li>• Carbon dioxide in oceans trapped in sedimentary rocks</li> <li>• Oxygen increased because green plants photosynthesised</li> <li>• Water vapour decreased because it condensed to liquid water.</li> <li>• Water vapour condensed because temperatures dropped</li> </ul> <p>Accept drop in volcanic activity may result in drop in carbon dioxide (assuming dissolving in oceans etc at same rate)</p> <p>Accept idea of different amounts of water being carried in by comets.</p> <p>Accept the idea of nitrogen levels increasing</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
<b>Total</b>			<b>8</b>	

Question	Answer	Marks	Guidance										
7 (a)	$t_p = 4750 \text{ km}/(7 \text{ km/s}) = 678.6 \text{ s (1)}$ ; $t_s = 4750 \text{ km}/(3 \text{ km/s}) = 1583.3 \text{ s (1)}$ ; lag time between = $1583 \text{ s} - 678 \text{ s} = 905 \text{ s} \approx 15 \text{ min (1)}$ or $t_p = 4750 \text{ km}/(7 \text{ km/s}) = 678/60 \text{ min} = 11.31 \text{ min (1)}$ ; $t_s = 4750 \text{ km}/(3 \text{ km/s}) = 1583.3/60 \text{ min} = 26.39 \text{ min (1)}$ ; lag time between = $26(.39) \text{ min} - 11(.31) \text{ min} \approx 15 \text{ min (1)}$	3	<p><b>accept</b> 678-679 s  <b>accept</b> 1583-1584 s.                      give credit for calculated quantities in s or min (678 s/ 11.31 min and 1583.3 s/26.39) without calculation shown; as a consequence '26.39 – 11.31 = 15.08 min' is all three marks</p> <p>if candidate uses an effective speed for the delay of <math>(7 - 3)\text{km/s} = 4 \text{ km/s}</math> giving <math>1187.5 \text{ s} = 19 \text{ min}</math>, give (1) total</p> <p>do not penalise missing units, only incorrect units. So 678 is acceptable but 678 min is wrong.</p>										
(b)	<table border="1" data-bbox="479 651 1016 831"> <tr> <td>There are no aftershocks ...</td> <td></td> </tr> <tr> <td>The S-waves die ...</td> <td></td> </tr> <tr> <td>The amplitude of S-waves ...</td> <td>✓</td> </tr> <tr> <td>The duration of P-waves ...</td> <td></td> </tr> <tr> <td>The time between the arrival ...</td> <td>✓</td> </tr> </table>	There are no aftershocks ...		The S-waves die ...		The amplitude of S-waves ...	✓	The duration of P-waves ...		The time between the arrival ...	✓	2	deduct one mark for each extra tick.
There are no aftershocks ...													
The S-waves die ...													
The amplitude of S-waves ...	✓												
The duration of P-waves ...													
The time between the arrival ...	✓												
(c)	<table border="1" data-bbox="479 898 1016 1078"> <tr> <td>... would not have P-waves.</td> <td></td> </tr> <tr> <td>.. would not have S-waves.</td> <td>✓</td> </tr> <tr> <td>... would have no aftershocks.</td> <td></td> </tr> <tr> <td>The amplitude of the waves ...</td> <td>✓</td> </tr> <tr> <td>The lag time between ....</td> <td></td> </tr> </table>	... would not have P-waves.		.. would not have S-waves.	✓	... would have no aftershocks.		The amplitude of the waves ...	✓	The lag time between ....		2	deduct one mark for each extra tick.
... would not have P-waves.													
.. would not have S-waves.	✓												
... would have no aftershocks.													
The amplitude of the waves ...	✓												
The lag time between ....													
	<b>Total</b>	<b>7</b>											

Question		Answer	Marks	Guidance																									
8	(a)	greater distance means greater speed (1); so Universe is getting bigger all the time (1)	2	if candidate specifically refers to 'star' or 'planet' rather than 'galaxy' in the correlation statement, no marks. award second mark only if first has been awarded.																									
	(b)	direct proportion: chooses $d$ & $v$ data pair (in order to calculate $d/v$ or $v/d$ ) (1); uses $50\,000 \times d/v$ or $50\,000 \div v/d$ (to calculate new $d$ ) (1); correct value rounded to 2 s.f. (1)  OR  interpolation: 50000 is more than half-way between 21000 & 67000 (1); it is 63% [about 2/3] of the way along that interval (1); 2/3 of 2000 + 1000 gives 2333 = 2300 Mly / 63% of 2000 + 1000 gives 2260 = 2300 Mly (1)	3	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><math>d</math></th> <th><math>v</math></th> <th><math>d/v</math></th> <th><math>v/d</math></th> <th>new <math>d</math></th> </tr> </thead> <tbody> <tr> <td>300</td> <td>6500</td> <td>0.0461</td> <td>21.7</td> <td>2300</td> </tr> <tr> <td>800</td> <td>18 000</td> <td>0.0444</td> <td>22.5</td> <td>2200</td> </tr> <tr> <td>1000</td> <td>21 000</td> <td>0.0476</td> <td>21.0</td> <td>2400</td> </tr> <tr> <td>3000</td> <td>67 000</td> <td>0.0448</td> <td>22.3</td> <td>2200</td> </tr> </tbody> </table> <p><b>allow</b> between 55% (gives 2100) and 75% (gives 2500)  give 1 mark for 2100, 2200, 2300, 2400 or 2500 if no working shown. You cannot assume a correct method here from the bald answer – it could well be an estimate.</p>	$d$	$v$	$d/v$	$v/d$	new $d$	300	6500	0.0461	21.7	2300	800	18 000	0.0444	22.5	2200	1000	21 000	0.0476	21.0	2400	3000	67 000	0.0448	22.3	2200
$d$	$v$	$d/v$	$v/d$	new $d$																									
300	6500	0.0461	21.7	2300																									
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	(c)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Very distant galaxies do not show...</td> <td></td> </tr> <tr> <td>The total mass ...</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>The distances to ...</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Very distant galaxies are observed...</td> <td></td> </tr> <tr> <td>Light pollution ...</td> <td></td> </tr> </tbody> </table>	Very distant galaxies do not show...		The total mass ...	✓	The distances to ...	✓	Very distant galaxies are observed...		Light pollution ...		2	deduct one mark for each extra tick.															
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Question	Answer	Marks	Guidance
9	<p><b>Level 3 (5–6 marks)</b> Complete mechanism for role of mantle in sea-floor spreading plus at least one consequence of sea-floor spreading. Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b> Incomplete mechanism for role of mantle in sea-floor spreading plus a consequence or complete mechanism of convection in the mantle without consequences. Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b> Describes one consequence of sea-floor spreading, but mechanism is incorrect, unclear or missing. Quality of written communication impedes communication of the science at this level.</p> <p><b>Level 0 (0 marks)</b> Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to C</b></p> <p><b>Indicative scientific points about consequences may include</b></p> <ul style="list-style-type: none"> <li>• explains mountain building, volcanoes, earthquakes.</li> <li>• magnetic stripes in crust on sea-floor</li> <li>• tectonic plates move apart</li> <li>• continental drift</li> <li>• justify aspects of Wegener's idea</li> </ul> <p><b>Indicative scientific points about mechanisms may include</b></p> <ul style="list-style-type: none"> <li>• Movement in mantle</li> <li>• Convection current pushing crust</li> <li>• molten rock exuded at mid-ocean ridge</li> <li>• new rocks formed in opening in crust</li> <li>• newer rocks close to gap &amp; older further off</li> <li>• crustal plates move slowly apart from mid-ocean ridge</li> </ul> <p><b>accept</b> discussion of Wegener's lack of acceptance by the scientific community <b>accept</b> description of symmetrical magnetic stripes as evidence (on H-tier Specification only)</p> <p><b>ignore</b> any references to religious authority</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
	<b>Total</b>	<b>6</b>	

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