

# **Additional Science A**

General Certificate of Secondary Education

Unit **A151/02**: Modules B4, C4, P4 (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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## Annotations

Used in the detailed Mark Scheme:

Annotation	Meaning
/	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	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in scoris to annotate scripts:

	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	no benefit of doubt
	reject
	correct response

L1, L2, L3	indicate level awarded for a question marked by level of response
▲	information omitted

**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

Manchester

Paris

Southampton

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<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)	links A to 14°C / sea temperature / sea bacteria / the lower of the two temperature ranges ORA  goes beyond shape of graph to <i>meaning</i> – maximum activity / optimum activity [of the enzyme] / denatures at specific temperature linked to graph	2	assume 'it' to mean enzyme A [see stem]  Any specified temperature must clearly belong to its appropriate graph  must imply [enzyme] activity, not just optimum temperature  "Because when enzyme A gets over 14°C its activity drops" = 2
	(b)	the curve will stay flat/will not rise up as far as the original did;  <b>one reference</b> to the enzyme not working  the enzyme would not work / would not work as well / it has been denatured / the active site has changed [shape] / the active site/enzyme no longer fits the substrate	2	Look for the answer on the graph itself <b>ignore</b> "straight line",  <b>ignore</b> "It doesn't go back to its regular shape" [doesn't say what the new shape is]
<b>Total</b>			<b>4</b>	

Question		Answer	Marks	Guidance
2	(a)	<p><b>Level 3 (5–6 marks)</b> Logical sequence mentioning nitrates, plant roots, active transport, incorporation into amino acids/proteins/dna <i>Quality of written communication does not impede communication of the science at this level.</i></p> <p><b>Level 2 (3–4 marks)</b> Logical sequence mentioning nitrogen compounds from the fertiliser, plant roots, plus a suitable piece of extra detail such as [active] transport, or the idea that the nitrogen compounds are then used to create other substances [not just for growth]. If terms such as osmosis or diffusion are used, they will probably be used incorrectly. <i>Quality of written communication partly impedes communication of the science at this level.</i></p> <p><b>Level 1 (1–2 marks)</b> Appreciates that unspecified nitrogen [gas/ molecules/ compounds] from the fertiliser are taken in through the plant roots. Implies either a [probably incorrect] mechanism for the take-up, OR that something then happens to these compounds once inside the plant. <i>Quality of written communication impedes communication of the science at this level.</i></p> <p><b>Level 0 (0 marks)</b> <i>Answer not worthy of credit.</i></p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Indicative scientific points may include:</b></p> <ul style="list-style-type: none"> <li>• nitrates absorbed by roots</li> <li>• active transport involved</li> <li>• uses energy from respiration</li> <li>• nitrate concentration in soil is less than in plant</li> <li>• nitrates combined with products of photosynthesis to form amino acids</li> <li>• amino acids assembled into proteins</li> <li>• seed is rich store of protein</li> </ul> <p><b>accept</b> nitrates are combined with glucose to make amino acids <b>reject</b> nitrates are amino acids <b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
	(b)	<p>oxygen anaerobic respiration ethanol/alcohol, carbon dioxide</p>	2	<p>4 correct = 2 1 correct = 1</p> <p><b>accept</b> CO<sub>2</sub> for carbon dioxide <b>accept</b> carbon dioxide, ethanol <b>accept</b> fermentation for anaerobic respiration</p>
<b>Total</b>			<b>8</b>	

Question		Answer	Marks	Guidance
3	(a)	$6 \text{CO}_2 + 6\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	1	<b>accept</b> products or reactants in either order cases and subscripts must be correct by eye
	(b)	18 to 21;	1	<b>accept</b> 21 to 18 accept 3 [ie 21-18]
		discusses outlier/identifies which is the faulty run	1	check that the answer wasn't written on the table or in 3bi the idea of an outlier may be explained rather than named. "knocks over the lamp" not enough for the explanation at this level.
	(c)	<b>any two from:</b>  increasing the light intensity is not increasing the rate of photosynthesis (1)  because other limiting factors apply (1)  names a suitable limiting factor (1)	2	ORA must refer to photosynthesis in some way [rather than bubbles]– accept unqualified 'It' [see wording of stem]. 'it' may have reached its limit = 1  <b>ignore</b> discussion of light as a limiting factor  <b>accept</b> temperature or carbon dioxide level or amount of chlorophyll as named limiting factors. Ignore pH  "carbon dioxide is a limiting factor" = 2
<b>Total</b>			<b>5</b>	

Question		Answer	Marks	Guidance										
4	(a)	between 0 and minus 3 inclusive	1											
		within the range 45 to 60 inclusive	1											
	(b)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="height: 20px;"></td><td style="width: 20px;"></td></tr> <tr><td style="height: 20px;"></td><td></td></tr> <tr><td style="height: 20px;"></td><td></td></tr> <tr><td style="height: 20px;">Repeat each concentration and calculate...</td><td style="text-align: center;">✓</td></tr> <tr><td style="height: 20px;"></td><td></td></tr> </table>							Repeat each concentration and calculate...	✓			1	
Repeat each concentration and calculate...	✓													
<b>Total</b>			<b>3</b>											

Question		Answer	Marks	Guidance																				
5	(a)	3, 2	1																					
		<table border="1"> <tr> <td></td> <td>s</td> <td>l</td> <td>g</td> <td>aq</td> </tr> <tr> <td>chlorine</td> <td></td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>iron</td> <td>✓</td> <td></td> <td></td> <td></td> </tr> <tr> <td>iron chloride</td> <td>✓</td> <td></td> <td></td> <td></td> </tr> </table>		s	l	g	aq	chlorine			✓		iron	✓				iron chloride	✓				1	all correct = 1
	s	l	g	aq																				
chlorine			✓																					
iron	✓																							
iron chloride	✓																							
	(b)	protons = 17 neutrons = 18 electrons = 17	2	all correct = 2 2 correct = 1 1 correct = 0																				
	(c)	<b>any three from:</b>  gains electron[s] / negative charge single electron transfer / single charge transfer (into its) outer shell (to make up) eight (in the outer shell)	3	3 points = 3 marks 2 points = 2 mark 1 point = 1 marks  gains <u>a</u> negative charge = 2 gains <u>an</u> electron = 2  gains one positive charge = 1 [ouch! single charge mark]																				
	(d)	symbols and formulae correct(1), balanced (1)  $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ or $\text{Cl}_2 + 2\text{Na} \rightarrow 2\text{NaCl}$	2	must be capital N in Na and C in Cl, but by eye, subscript by eye balanced – there is no need for a '1' in front of the Cl <sub>2</sub> , but accept it if there. formulae must be correct before the balancing mark can be awarded. <b>ignore</b> charges on the formulae																				

Question		Answer	Marks	Guidance
	(e)	lattice; regular; ions	3	<b>accept</b> 'cubic' as regular <b>accept</b> alternative to 'regular' eg 'ordered'  <b>accept</b> ionic bonding/electrostatic references for the third point . If ionic AND covalent, CON for the third point only  <b>ignore</b> 'tight packing', <b>ignore</b> terms such as 'negative atom' <b>accept</b> information from a diagram eg regularity, ions
	(f)	ions can move	2	<b>ORA</b> movement must be of ions <b>ignore</b> freed assume that the candidate is talking about the solution unless context shows it to be otherwise
<b>Total</b>			<b>14</b>	

Question	Answer	Marks	Guidance
6	<p><b>Level 3 (5–6 marks)</b> The candidate selects several of the points, and links at least two of them to correct reasons why each indicate membership or not of the group. <i>Quality of written communication does not impede communication of the science at this level.</i></p> <p><b>Level 2 (3–4 marks)</b> The candidate selects one or more of the points, and links one of them to a correct reason why it indicates membership or not of the group. May also suggest inappropriate/ insufficient reasons. <i>Quality of written communication partly impedes communication of the science at this level.</i></p> <p><b>Level 1 (1–2 marks)</b> The candidate identifies one or more suitable points, but gives no correct reason. <i>Quality of written communication impedes communication of the science at this level.</i></p> <p><b>Level 0 (0 marks)</b> The candidate selects only inappropriate points for their choice. OR transfers all the information from the table without comment.</p>	6	<p><b>This question is targeted at grades up to C</b></p> <p><b>Indicative scientific points may include:</b></p> <p>property and reason for being in a group/Jo correct</p> <ul style="list-style-type: none"> <li>• formulae of chlorides - the same</li> <li>• formula of oxides - the same</li> <li>• reactivity - fits a trend</li> <li>• densities - fit a trend</li> </ul> <p>property and reason not being in a group / Ann correct</p> <ul style="list-style-type: none"> <li>• melting points of elements - don't fit a clear trend</li> <li>• melting points of oxides - don't fit a clear trend</li> </ul> <p>other points</p> <ul style="list-style-type: none"> <li>• formulae give a very strong indication of group</li> <li>• Identifies the group as group 2</li> <li>• realises that Y is a metal / they are all metals</li> <li>• identifies Y as magnesium</li> </ul> <p><b>Insufficient or inappropriate reasoning</b></p> <ul style="list-style-type: none"> <li>• melting points are all similar</li> <li>• melting points show a clear trend</li> <li>• reference to boiling points</li> <li>• densities are all similar</li> <li>• reactions with water too different to be one group</li> <li>• reactions with water very similar</li> <li>• proton number increases down a group</li> <li>• proton number itself is not a useful indication</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
7	(a)	<p>There is no friction to transfer energy ... <input checked="" type="checkbox"/></p> <p>The kinetic energy of the trolley does not ... <input type="checkbox"/></p> <p>The total energy of an isolated system ..... <input checked="" type="checkbox"/></p> <p>The weight of the trolley decreases .... <input type="checkbox"/></p> <p>The force pulling the trolley along ... <input type="checkbox"/></p>	1	needs both correct for (1)
	(b)	<p>work done = <math>4.8 \times 0.25 = 1.2 \text{ J}</math>;</p> <p>gpe gained = <math>6.0 \times 0.15 = 0.9 \text{ J}</math>;</p> <p>doesn't support her prediction</p>	3	<p><b>ignore</b> unqualified yes/no</p> <p><b>ignore</b> units</p> <p><b>accept</b> valid conclusion from ecf from calculations</p>
<b>Total</b>			<b>4</b>	

Question	Answer	Marks	Guidance
8	<p><b>Level 3 (5–6 marks)</b> Discusses the problem in terms of <i>change</i> in movement, frictional forces and momentum change, including points from all three categories. <i>Quality of written communication does not impede communication of the science at this level.</i></p> <p><b>Level 2 (3–4 marks)</b> Links friction to [change in] movement for each case Gives some of the key physics used correctly – eg discusses forces/ interaction pairs <i>Quality of written communication partly impedes communication of the science at this level.</i></p> <p><b>Level 1 (1–2 marks)</b> Compares the amount of friction with both grass and ice. Discusses ease of slipping/ grip. <i>Quality of written communication impedes communication of the science at this level.</i></p> <p><b>Level 0 (0 marks)</b> Discusses friction for only one of the surfaces, but gives no extra detail.</p> <p>Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Indicative scientific points may include:</b></p> <p><b>key physics</b></p> <ul style="list-style-type: none"> <li>• force is friction</li> <li>• why the friction on grass is greater</li> <li>• direction is against direction of motion</li> <li>• force is horizontal [<b>ignore</b> upwards]</li> <li>• to start walking requires momentum change</li> <li>• force is needed for momentum change</li> <li>• interaction pairs</li> </ul> <p><b>ice</b></p> <ul style="list-style-type: none"> <li>• no/small friction so foot slips</li> <li>• no/small interaction pair of forces</li> <li>• foot cannot transfer momentum to the ice</li> <li>• momentum/speed of body does not change.</li> </ul> <p><b>grass</b></p> <ul style="list-style-type: none"> <li>• friction stops the foot slipping</li> <li>• there is an interaction pair of forces</li> <li>• foot can transfer momentum to ground</li> <li>• body gains equal and opposite momentum.</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>ignore</b> forces in the non-horizontal direction eg gravity <b>ignore</b> resultant forces</p>
	<b>Total</b>	6	

Question			Answer	Marks	Guidance					
9	(a)	(i)	6.3	1						
		(ii)	$2.1 \times 10^5$ N or 210 000 N or 210 kN	1	<b>ignore</b> statement of mathematical formula – it is on the formula sheet <b>accept</b> ecf from ai 63: $2.1 \times 10^6$ , 630: $2.1 \times 10^7$ , 6300: $2.1 \times 10^8$					
	(b)	(i)	<p><b>any two of the following</b>, (1) each</p> <ul style="list-style-type: none"> <li>bullet can travel further as it stops;</li> <li></li> <li>so takes <b>longer/more time</b> to stop</li> </ul> <ul style="list-style-type: none"> <li>reducing force / reducing rate of change of momentum</li> </ul>	2	<p><b>ignore</b> clumsy reference to time “slows the time”, “slows the impact”</p> <p>eg less damage/ hurt you less/ cause less bruising</p> <p><b>ignore</b> slows the bullet down more, changes the momentum, impact, cushioning</p>					
		(ii)	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">C</td> <td style="text-align: center;">E</td> <td style="text-align: center;">B</td> <td style="text-align: center;">D</td> </tr> </table>	A	C	E	B	D	2	leaves out <b>F</b> (1) correct pattern (2)
A	C	E	B	D						
		(iii)	Bess	1						
<b>Total</b>				<b>7</b>						

Question		Answer	Marks	Guidance
10	(a)	CitiStrol is $2.5 \text{ m/s}^2$ EasyShop is $3.0 \text{ m/s}^2$ GoFar is $5.0 \text{ m/s}^2$	2	all three correct for (2) any two or one correct for (1) <b>ignore</b> unqualified answer of yes if the answer is not in the official space look elsewhere  <b>ignore</b> reference just to time taken – they must calculate an acceleration. <b>ignore</b> units if conclusion does not agree with candidate's numerical answers, CON for one of the marks
	(b)	120 000 J	1	
<b>Total</b>			<b>3</b>	

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