

**Additional Science B**

General Certificate of Secondary Education

Unit **B721/01**: Modules B3, C3, P3 (Foundation 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.

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For answers marked by levels of response:

- a. **Read through the whole answer from start to finish**
- b. **Decide the level that best fits** the answer - match the quality of the answer to the closest level descriptor
- c. **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

- d. Use the L1, L2, L3 annotations in Scoris to show your decision; do not sue ticks.

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

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

## Annotations

Annotation	Meaning
	correct response
	incorrect response
<b>BOD</b>	benefit of the doubt
<b>NBOD</b>	benefit of the doubt <b>not</b> given
<b>ECF</b>	error carried forward
	information omitted
<b>I</b>	ignore
<b>R</b>	reject
<b>CON</b>	contradiction
<b>L1</b>	Level 1
<b>L2</b>	Level 2
<b>L3</b>	Level 3

**Subject specific Marking Instructions**

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

Question			Answer	Marks	Guidance
1	(a)	(i)	diameter (of the onion) (1)	1	<b>allow</b> width <b>ignore</b> time
		(ii)	wider / widest / bigger / biggest (1)	1	<b>answer must be a comparison</b> <b>but allow</b> it has a diameter of 50 (cm) <b>allow</b> grew more <b>ignore</b> grows faster / better
	(b)		<b>any two from:</b>  (idea of) use a layer (of onion tissue) (1)  put a stain on it (1)  use of cover slip (1)	2	<b>allow thin</b> piece / <b>thin</b> slice / one cell thick piece (of onion) / so light can pass through <b>ignore</b> just small / slice / skin / little strip / use a cell  <b>allow</b> put iodine on it / use a dye <b>ignore</b> use ink  <b>allow</b> cover with a (microscope) slide
			<b>Total</b>	<b>4</b>	

Question		Answer	Marks	Guidance
2	(a)	respiration (1)  so that the muscles can contract (1)	2	<b>allow</b> to release energy / for energy / give energy to muscles / provides energy for muscles <b>ignore</b> to <b>store</b> energy / <b>make</b> energy / <b>produce</b> energy  <b>allow</b> so muscles can move / muscles can work  <b>allow</b> muscles need energy to contract (2) <b>allow</b> muscle cells need energy to work (2)
	(b) (i)	(idea that) the fitter a person is, the higher their VO <sub>2</sub> Max / the more strenuous the sport, the higher their VO <sub>2</sub> Max (1)	1	<b>allow</b> ORA <b>allow</b> a sportsman has a higher VO <sub>2</sub> Max / ORA <b>allow</b> the more sports you do the higher VO <sub>2</sub> Max / ORA <b>allow</b> the fitter a person is, the bigger the range of VO <sub>2</sub> Max / ORA <b>allow</b> positive (relationship)
	(ii)	60 = 2 marks but indication of resting rate of 50 <b>and</b> maximum rate of 200 = 1	2	<b>allow</b> indication of values marked on graph
	(iii)	No, because the minimum for a cross-country skier is 65 / not in range 65-94 (1)	1	<b>allow</b> idea of outside the range eg because a cross-country skier is in the range of 64-95 / 'it is not high enough' / below the range / to be a cross country skier he would have to increase his VO <sub>2</sub> Max by 5  <b>allow</b> ECF from b) ii)

Question		Answer	Marks	Guidance
	(c) (i)	<p><b>any two from:</b></p> <p><b>more</b> blood (pumped per heart beat) (1)</p> <p>so <b>more</b> oxygen / <b>more</b> glucose (1)</p> <p><b>more</b> respiration possible (1)</p> <p><b>but</b></p> <p><b>more</b> blood to the muscles (2)</p> <p><b>more</b> oxygen to the muscles / <b>more</b> glucose to the muscles (2)</p>	2	<p><b>allow</b> blood pumped more quickly</p> <p><b>allow</b> heart can pump with slower heart beat but with same results</p> <p><b>allow</b> (muscles get) oxygen quicker / (muscles get) glucose quicker</p> <p><b>ignore</b> more oxygen is made</p> <p><b>allow</b> more oxygenated blood (2)</p>
	(ii)	<p>platelets will clot the blood (1)</p> <p>will not get pumped out / block blood vessels (1)</p>	2	<p><b>allow</b> clots in the blood</p> <p><b>allow</b> (idea that) the blood cannot flow / less blood flow / blood moves slower</p> <p><b>allow</b> blocks the chambers (of the heart)</p> <p><b>ignore</b> causes heart attack / heart disease</p>
	(iii)	<p>percentage in the sample (13 out of 78 / 16.7%)</p> <p>is similar to the percentage in the whole population / 15% (1)</p>	1	<p><b>answer must have a comparison</b></p> <p><b>allow</b> 15% of 78 is close to 13</p> <p><b>allow</b> 15% of whole population have fibrillation <b>and</b> haven't skied</p> <p><b>ignore</b> same number in the sample as in the whole population</p>
<b>Total</b>			<b>11</b>	

Question	Answer	Marks	Guidance
3	<p><b>Level 3 (5–6 marks)</b>                      Answer includes information about natural cloning in plants <u>and</u> animals  <b>AND</b>                      Answer includes information about artificial cloning in plants <u>and</u> animals                      Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b>                      Answer includes information about natural cloning in plants <u>or</u> animals <b>AND</b> includes simple information about artificial cloning in plants <u>or</u> animals  <b>OR</b>                      Answer includes information about natural cloning in plants <u>and</u> animals  <b>OR</b>                      Answer includes information about artificial cloning in plants <u>and</u> animals                      Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b>                      Answer includes information about natural cloning  <b>OR</b>                      Answer includes information about artificial cloning                      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 up to grade E</b></p> <p><b>Relevant points include:</b></p> <p><b>Natural cloning:</b></p> <ul style="list-style-type: none"> <li>• natural cloning is an example of asexual reproduction / mitosis</li> <li>• natural cloning produces genetically identical copies</li> <li>• named example or description of natural cloning in plants e.g. bulbs / potatoes / runners / strawberries</li> <li>• named example or description of natural cloning in animals e.g. identical twins</li> </ul> <p><b>Artificial cloning:</b></p> <ul style="list-style-type: none"> <li>• artificial cloning produces genetically identical copies</li> <li>• named example or description of artificial cloning in plants e.g. cuttings / tissue culture</li> <li>• named example or description of artificial cloning in animals e.g. Dolly the sheep</li> </ul> <p><b>allow</b> higher level answers about tissue culture techniques / nuclear transfer / genetic engineering</p> <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
4	(a)	mutation (1)	1	
	(b)	(i) lactic acid is made (1) by anaerobic respiration (1)	2	<b>ignore</b> anaerobic exercise <b>as an extra marking point</b> <b>allow</b> carbon dioxide is released / idea of more carbon dioxide
		(ii) do not fit through (small) blood vessels (so easily) / get tangled / clumped together (1)	1	<b>allow</b> named blood vessels  <b>allow</b> (idea that they) do not flow easily / do not have such a large surface area / do not absorb oxygen so quickly / less oxygen carried / less oxygen absorbed / less haemoglobin carried  <b>not</b> no oxygen is carried
		<b>Total</b>	<b>4</b>	

Question		Answer	Marks	Guidance
5	(a)	<p><b>any one from:</b></p> <p>hard (1)</p> <p>high melting point (1)</p>	1	<p><b>allow</b> hard wearing / it can't be scratched</p> <p><b>ignore</b> durable / hard to break / good at cutting things</p> <p><b>ignore</b> strong / sharp / dense</p> <p><b>allow</b> it will not melt</p> <p><b>as an extra marking point</b></p> <p><b>allow</b> (good) thermal conductor</p>
	(b)	<p><b>any two from:</b></p> <p>black (1)</p> <p>lustrous or shiny (1)</p> <p>opaque (1)</p> <p>slippery (1)</p> <p>(good) conductor of electricity (1)</p> <p>high melting point (1)</p>	2	<p><b>allow</b> (have layers that) slide</p> <p><b>ignore</b> soft / lubricant</p> <p><b>ignore</b> (good) conductor</p> <p><b>as an extra marking point</b></p> <p><b>allow</b> correct chemical properties e.g. burning to give carbon dioxide</p>
		<b>Total</b>	<b>3</b>	

Question		Answer	Marks	Guidance
6	(a)	<p><b>continuous</b> runs all the time / constantly being made / made 24 / 7 / production does not start and stop / AW (1)</p> <p><b>batch</b> made on demand / when it is needed (1)</p>	2	<p><b>allow</b> ORA for batch e.g. batch makes a quantity and then there is a break in production</p> <p><b>allow</b> ORA for continuous e.g. continuous is being made even when it is not required</p> <p><b>ignore</b> lots made / small amounts made</p>
	(b)	(i)	1	<p><b>allow</b> both ringed</p> <p><b>ignore</b> name of reactant ringed <b>but</b> if anything incorrect ringed = 0 marks</p> <p>if nothing ringed in the equation allow the reactant or reactants ringed in the table</p>
		(ii)	1	

Question	Answer	Marks	Guidance
(iii)	83.1 (%) scores (2) if answer incorrect for one mark: $\frac{180 \times 100}{216.5} \quad \text{or} \quad \frac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all products}}$ $\text{or} \quad \frac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all reactants}} \quad \text{or} \quad \frac{180 \times 100}{138 + 78.5}$ $\text{or} \quad \frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}} \quad \text{or} \quad \frac{180}{138 + 78.5}$ $\text{or} \quad \frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}} \quad \text{or} \quad \frac{180}{180 + 36.5}$	2	<b>allow</b> 83 / any number of decimal places if rounded correctly eg 83.141 (2)  but if rounded incorrectly eg 83.140 (1)
(c)	(idea of) safe to use / to check they are safe / to check for side effects / they could be harmful / to make sure they are not harmful (1)	1	<b>allow</b> to check they will work / to see if they can be improved
	<b>Total</b>	<b>7</b>	

Question	Answer	Marks	Guidance
7	<p><b>Level 3 (5–6 marks)</b>  <b>Answer includes a detailed description of the method AND Explains why fuel C is the fuel which gives out most energy.</b>  Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b>  <b>Answer includes a reasonable description of the method AND attempts to work out which fuel gives out most energy</b>  Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b>  <b>Answer includes a limited description of the method OR attempts to work out which fuel gives out most energy</b>  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 up to grade C</b>  <b>Relevant points at level 3 include:</b></p> <ul style="list-style-type: none"> <li>• method includes same amount of water in calorimeter</li> <li>• measure temperature before and after heating or measure temperature rise</li> <li>• measure mass of burner before and after or mass of fuel burned</li> <li>• fuel C identified due to least mass of fuel burned for same temperature rise</li> </ul> <p><b>Relevant points at level 2 include:</b></p> <ul style="list-style-type: none"> <li>• water in calorimeter</li> <li>• fuels in the burner</li> <li>• correct reference to a fair test</li> <li>• measure temperature before and after heating or measure temperature rise</li> <li>• measure mass of burner before and after or mass of fuel burned</li> <li>• some evidence of <b>correctly</b> processing data e.g. the temperature has increases by 20<sup>0</sup>C / uses the least fuel</li> </ul> <p><b>Relevant points at level 1 include:</b></p> <ul style="list-style-type: none"> <li>• water in calorimeter</li> <li>• fuels in the burner</li> <li>• correct reference to a fair test</li> <li>• measure temperature</li> <li>• measure mass of fuel</li> <li>• some evidence of <b>correctly</b> processing data e.g. same temperature rise / orders the amount of fuel used</li> </ul> <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
8	(a)	magnesium + hydrochloric acid → magnesium chloride + hydrogen (1)	1	<p><b>not</b> and or &amp; for +  <b>allow</b> = instead of →  <b>allow</b> correct formulae or mix of words and correct formulae  <b>allow</b> <math>\text{Mg} + \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2</math>            ie symbol equation does not have to be balanced  <b>not</b> '+ energy or + heat' on either side of equation  <b>ignore</b> 'heat' written above the arrow  <b>not</b> an equation including lumps / solution / gas</p>
	(b)	(i) 20 (seconds) (1)	1	
		(ii) 106 (cm <sup>3</sup> ) (1)	1	
	(c)	acid runs out / magnesium used up (1)	1	<p><b>allow</b> 'not enough acid available'  <b>allow</b> no more <b>reactant</b>(s) / no more chemicals (to react)  <b>allow</b> all of the magnesium has dissolved  <b>ignore</b> no more gas / no more bubbles produced  <b>ignore</b> no more successful collisions</p>
	(d)	(rate of reaction) increases (1)  more surface area (of magnesium or powder) (1)	2	<p><b>allow</b> faster reaction</p> <p><b>ignore</b> more powder / more particles</p> <p><b>allow</b> higher level answers in terms of collisions e.g. more frequent collisions (between acid and magnesium)</p>

Question		Answer	Marks	Guidance
	(e)	<p><b>any three from:</b>            increase temperature (of acid) / hotter (acid) / AW (1)            use more concentrated acid / AW (1)            use a catalyst (1)            stir / shake (1)</p>	3	<p><b>allow</b> heat (the acid)</p> <p><b>ignore</b> use more acid / stronger acid</p> <p><b>ignore</b> pressure / pH</p> <p><b>allow</b> explanations of methods given e.g.            increase temperature (1) because particles have more energy / particles move faster (1) and more collisions (1)</p> <p>increase concentration (1) because particles are more crowded (1) and more collisions (1)</p> <p>add a catalyst (1) which will speed up the reaction whilst remaining unchanged itself (1)</p>
<b>Total</b>			<b>9</b>	

Question		Answer	Marks	Guidance
9	(a)	D (1)	1	more than one answer circled = 0 marks
	(b)	Z (1)	1	more than one answer circled = 0 marks
	(c)	(i) (a large) force (on the person) (1)	1	<b>ignore</b> push / g force / friction / momentum
		(ii) <b>any two from:</b> absorbs energy (1) padding squashes / changes shape (1)  idea of keeping in seat / AW (1)	2	<b>ignore</b> reduces the impact / absorbs force  <b>allow</b> padding acts as a cushion <b>ignore</b> padding takes the force  <b>allow</b> stops the person moving (out of the seat) <b>ignore</b> reduces injury  <b>as extra marking points</b> <b>allow</b> idea of reduced force (on person) (1)  <b>allow</b> idea of increased stopping time (1)  <b>allow</b> idea of reduced acceleration / deceleration (1)
		<b>Total</b>	<b>5</b>	

Question	Answer	Marks	Guidance
10	<p><b>Level 3 (5–6 marks)</b>  <b>Compares the accelerations for Helen and Finn over the whole race.</b>  Quality of written communication does not impede communication of the science at this level.</p> <p><b>Level 2 (3–4 marks)</b>  <b>Describes the different accelerations for Helen AND Describes the different accelerations for Finn</b>  Quality of written communication partly impedes communication of the science at this level.</p> <p><b>Level 1 (1–2 marks)</b>  <b>Describes the different accelerations for Helen OR Describes the different accelerations for Finn OR Describes the accelerations for Helen and Finn for part of the race</b>  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 up to grade C</b></p> <p><b>Relevant points at level 3 include:</b></p> <ul style="list-style-type: none"> <li>• between 0 seconds and 900 seconds Finn’s <b>acceleration</b> is greater than Helen’s <b>acceleration</b> / between 0 seconds and 900 seconds they have different <b>accelerations</b> / ORA</li> <li>• between 900 seconds and 1800 seconds Helen is moving with steady speed / not acceleration (or decelerating) but Finn is decelerating (at the same rate as he accelerated).</li> </ul> <p>need a <b>correct</b> calculation or time references in comparisons</p> <p><b>Relevant points at level 1 and 2 include:</b></p> <ul style="list-style-type: none"> <li>• at the start Helen is accelerating / increasing in speed / graph has a positive gradient</li> <li>• at the start Finn is accelerating / increasing in speed / has a positive gradient</li> <li>• towards the end Helen is not accelerating / Helen moves with constant speed / graph is flat</li> <li>• towards the end Finn is decelerating / is slowing down / decreasing in speed / graph has a negative gradient</li> </ul> <p>if answer only contains information about shape of graph then limited to level one</p> <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
	<b>Total</b>	<b>6</b>	

Question		Answer	Marks	Guidance
11	(a)	watt (1)	1	more than one answer circled = 0 marks
	(b)	diesel (1) small (1) any number less than 4.0 (1)	3	
		<b>Total</b>	<b>4</b>	

Question			Answer	Marks	Guidance
12	(a)	(i)	(Braking distance is the distance taken to stop once the) brakes have been applied / pressed (1)	1	<b>allow</b> (brake) pedal has been pushed  <b>not</b> once the driver has thought about pressing the brakes
		(ii)	(idea that) the deeper the tyre depth the shorter the braking distance / ORA (1)  <b>and any one from:</b>  so (with deeper tread) less likely to crash / AW (1)  so (with deeper tread) it stops quicker / so (with deeper tread) it takes less time to stop (1)	2	<b>ignore</b> comparisons between good tread and bad tread  <b>ignore</b> less dangerous but <b>allow</b> lets the driver control the car
	(b)		<b>advantages</b> <b>max two marks from:</b>  safer for longer / AW (1)  tyre would not need replacing as much (1)  has a shorter braking distance for longer (2)  <b>disadvantages</b> <b>max two marks from:</b>  (idea that) wear of the tyre is not linear (1)  (idea that) tyre can quickly change from safe to unsafe (1)  (idea that) need to check the tyre more often once it reaches 4mm or less tread / replace once it reaches 4mm (1)	3	<b>ignore</b> the tyre (tread) lasts longer        <b>ignore</b> tread of tyre goes down faster  <b>allow</b> the tyre suddenly becomes unsafe /once it reaches 4mm it increases in braking distance rapidly
<b>Total</b>				<b>6</b>	

Question		Answer	Marks	Guidance
13	(a)	air resistance (1)	1	<b>allow</b> drag / friction / resistance <b>ignore</b> upthrust
	(b)	<b>any one from:</b> reduce the (horizontal surface) area (1) (idea) of moving to a vertical or standing position (1) roll into a ball shape / move arms in (1)	1	<b>allow</b> make streamlined / make aerodynamic / dive head first (1)
	(c)	terminal speed will be less (than 50 m / s) (1) <b>and one from:</b> (idea that) more force (against movement) (1) (idea that) more drag or more air resistance or more friction (against movement) (1) greater (surface) area (1) decreased resultant force (1)	2	<b>not</b> more gravity <b>ignore</b> upthrust
		<b>Total</b>	<b>4</b>	

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