

Additional Science B

General Certificate of Secondary Education

Unit **B721/02**: Modules B3, C3, P3 (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.

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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
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	Level 3

Subject-specific Marking Instructions

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	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)	<p>cross-country skiers use both their arms and legs (to move around) (1)</p> <p>cross-country skiers need increased supply of energy in both arms and legs / mitochondria release energy / mitochondria are site of respiration / more mitochondria so more respiration (1)</p>	2	<p>allow runners mainly use their legs / only use their legs / runners do not use arms / use arms less / runners use their legs more than their arms</p> <p>ignore runners use their legs / runners use their legs more</p> <p>allow runners only need an increase supply of energy in legs</p> <p>ignore make energy / produce energy</p>
	(b)	(i)	1	ignore they do not use oxygen / use little oxygen
		(ii)	2	allow indication of values marked on graph
		(iii)	1	<p>allow idea of outside the range eg because a cross-country skier is in the range of 65-94 / 'it is not high enough' / below the range / to be a cross country skier he would have to increase his VO₂ Max by 5</p> <p>allow ECF from b) ii)</p>
	(c)	(i)	1	allow atrium / auricle
		(ii)	1	<p>answer must have a comparison</p> <p>ignore same number in the sample as in the population</p> <p>allow 15% of 78 is close to 13</p> <p>allow 15% of whole population have fibrillation and haven't skied</p>
Total			8	

Question	Answer	Marks	Guidance
2	<p>Level 3 (5–6 marks) Answer includes an explanation of what stem cells are and why stem cells are useful to treat certain conditions. It also includes an explanation of the difference between embryonic and adult stem cells and relates this to their potential for cure. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Answer includes an explanation of what stem cells are and why they might be useful for therapeutic reasons. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Some details of the nature of stem cells or their potential use in the body. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades D to A</p> <p>Relevant points include:</p> <p>Embryonic v Adult stem cells:</p> <ul style="list-style-type: none"> • Embryonic stem cells can form all types of cells • Adult stem cells only form certain types of cells • Adult stem cell use is going to be limited to repairing tissues with those cell types. • Embryonic stem cells less likely to be rejected <p>Why are they useful:</p> <ul style="list-style-type: none"> • Can be used to replace cells / treat medical conditions • Only really useful to replace cells that have been injured or degenerated, not those with genetic abnormalities • If stem cells are from baby's own umbilical cord they are unlikely to be rejected. <p>What stem cells are:</p> <ul style="list-style-type: none"> • Stem cells are undifferentiated / Can form other types of cells <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
	Total	6	

Question		Answer	Marks	Guidance
3	(a)	<p>reacts with oxygen / combines with oxygen / carries oxygen / transports oxygen / forms oxyhaemoglobin (1)</p> <p>at the lungs (1)</p> <p>reaction with oxygen is reversed / oxygen is released at tissues (1)</p>	3	<p>ignore picks up / collects / absorbs / stores answer must refer to haemoglobin and not red blood cells</p> <p>need first marking point to score this mark reacts with oxygen at the lungs scores 2</p> <p>allow cells / organs for tissues ignore oxygen is supplied / oxygen is dropped off</p>
	(b)	<p>change in the base sequence (of DNA) (1)</p> <p>means that different amino acids will be coded for (1)</p>	2	<p>allow change in (DNA) base code / change in base order / change in base triplets ignore different bases are used allow nucleotide for base</p> <p>ignore different number of amino acids allow different order of amino acids</p>
	(c)	<p>any two from</p> <p>do not fit through capillaries so easily / gets trapped in capillaries (1)</p> <p>do not have such a large surface area (1)</p> <p>takes up / releases oxygen slower (1)</p>	2	<p>not arteries or veins allow blood vessels</p> <p>ignore carries less oxygen / carries less haemoglobin / harder to pick up oxygen</p>
Total			7	

Question		Answer	Marks	Guidance
4	(a)	mitosis (1)	1	not meiosis
	(b) (i)	A before B (1) B before C (1)	2	
	(ii)	too small / below the resolving power of the light microscope (1)	1	allow very small allow need an electron microscope to see them (1) allow magnification of (light) microscope is too low (1)
		Total	4	

Question		Answer	Marks	Guidance
5	(a)	hard (1) high melting point (1)	2	allow hard wearing / it can't be scratched ignore durable / hard to break / good at cutting things ignore strong / sharp / dense allow it will not melt as an extra marking point allow (good) thermal conductor
	(b)	weak bonds between layers / layers can slide over each other (1)	1	allow references to weak (intermolecular) forces between layers not (weak) covalent bonds between layers allow sheets for layers / plates for layers
Total			3	

Question		Answer	Marks	Guidance
6	(a)	<p>83.1 (%) scores (2)</p> <p>if answer incorrect for one mark:</p> $\frac{180 \times 100}{216.5} \quad \text{or} \quad \frac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all products}}$ <p>or $\frac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all reactants}}$ or $\frac{180 \times 100}{138 + 78.5}$</p> <p>or $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}}$ or $\frac{180}{138 + 78.5}$</p> <p>or $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}}$ or $\frac{180}{180 + 36.5}$</p>	2	<p>allow 83 / any number of decimal places if rounded correctly eg 83.141 (2)</p> <p>but if rounded incorrectly eg 83.140 (1)</p>
	(b)	<p>any two from:</p> <p>idea of reduce production of unwanted products / ORA (1)</p> <p>idea of making the process (more) sustainable (1)</p> <p>maximise profit (1)</p>	2	<p>allow to make only wanted products / less waste product</p> <p>ignore reduce waste reactants</p> <p>ignore reduce waste unqualified</p> <p>ignore references to the environment</p> <p>ignore unqualified references to cost</p> <p>allow qualified reference to cost eg it costs less for raw materials / cost less in disposing waste</p> <p>allow help profits</p>

Question		Answer	Marks	Guidance
	(c)	<p>any two from: long timescale for testing / developing (1) named problem arising from human trials (1) named problem arising from animal trials (1) labour costs / labour intensive (1) have to meet legal requirements (1) raw materials may be difficult to obtain / expensive (1)</p>	2	<p>eg difficult to find volunteers / risk involved</p> <p>eg animals may respond differently to humans / ethical issues</p> <p>allow need to use highly qualified staff</p>
		Total	6	

Question	Answer	Marks	Guidance
7	<p>Level 3 (5–6 marks) Answer includes a description of the method, and Uses the correct calculation techniques to show that fuel C is the fuel which gives out most energy per g.</p> <p>Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Answer includes a description of the method and one step in each calculation is correct.</p> <p>or correct calculations of the energy given out by B and C per g. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Answer includes a limited description of the method or one step in each calculation is correct.</p> <p>Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades D to A*</p> <p>Relevant points at level 3 include:</p> <ul style="list-style-type: none"> • Idea that fuel is being burnt to heat water • Temperature measured before and after heating or measure temperature rise or measure mass of burner before and after or mass of fuel burned • fuel C calculated as 21000 (J / g) and fuel B calculated as 13125 (J / g). <p>Relevant points at level 2 include:</p> <ul style="list-style-type: none"> • Idea that fuel is being burnt to heat water • measure temperature before and after heating or measure temperature rise or measure mass of burner before and after or mass of fuel burned • eg each temperature change (B is 25°C and C is 20 °C) • fuel C calculated as 21000 (J / g) and fuel B calculated as 13125 (J / g). <p>Relevant points at level 1 include:</p> <ul style="list-style-type: none"> • idea that fuel is being burnt (to heat water) or measure temperature or measure mass of fuel • eg each temperature change (B is 25°C and C is 20 °C) • each energy change [B is 10500 (J) and C is 8400 (J)] <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
	Total	6	

Question		Answer	Marks	Guidance	
8	(a)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae but allow one mark for balanced equation with minor errors of subscripts, superscripts, etc eg $\text{MG} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}^2$ not and or & for + allow = instead of \rightarrow allow correct multiples eg $2\text{Mg} + 4\text{HCl} \rightarrow 2\text{MgCl}_2 + 2\text{H}_2$	
	(b)	(i)	106 (cm ³)	1	
		(ii)	2.5 cm ³ / s scores (2) but if answer incorrect then 50 scores (1) 20	2	allow answers in range 2.45 – 2.55 2.5 with no units or incorrect units scores 1 allow 150cm ³ / min (2) $\frac{49}{20}$ to $\frac{51}{20}$ (1)
	(c)	idea that (acid) particles move faster or have more energy (1) idea that there are more (frequent) collisions (between acid and magnesium particles) (1) but idea that there are more successful / energetic / effective / harder collisions (between acid and magnesium particles) (2)	3	ignore vibrate more allow more chance of a collision ignore faster collisions all marking points are comparative	
	(d)	more surface area (on magnesium) (1) more (frequent) collisions (between acid and magnesium particles) (1)	2	allow reverse argument for lumps / more particles exposed (on the surface) allow collisions are more likely allow reverse argument for lumps all marking points are comparative	
Total			10		

Question		Answer	Marks	Guidance
9	(a)	the height is the greatest / h is the greatest (1)	1	allow it is higher / has furthest to fall / the more the height, the greater the energy ignore it is high
	(b)	no (no mark) car W has mass (and velocity so has momentum) (1)	1	ignore weight
	(c)	any two from: spreads the change in momentum over a longer period of time / increases the stopping time (1) decreases the acceleration (of the person) (1) increases the stopping distance (1) decreases the force (on the person) (1)	2	ignore keeps people in their seat ignore references to energy ignore references to collision time ignore slows down deceleration
		Total	4	

Question	Answer	Marks	Guidance
10	<p>Level 3 (5–6 marks) Compares the accelerations for Helen and Finn over the whole race. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Describes the different accelerations for Helen and Describes the different accelerations for Finn Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Describes the different accelerations for Helen Or Describes the different accelerations for Finn Or Describes an acceleration for both Helen and Finn for only part of the race Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted up to grade C</p> <p>Relevant points at level 3 include:</p> <ul style="list-style-type: none"> • between 0 seconds and 900 seconds Finn's acceleration is greater than Helen's acceleration / between 0 seconds and 900 seconds they have different accelerations / ORA • 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). <p>Need a correct calculation or time references in comparisons</p> <p>Relevant points at level 1 and 2 include:</p> <ul style="list-style-type: none"> • at the start Helen is accelerating / increasing in speed / graph has a positive gradient • at the start Finn is accelerating / increasing in speed / has a positive gradient • towards the end Helen is not accelerating / Helen moves with constant speed / graph is flat • towards the end Finn is decelerating / is slowing down / decreasing in speed / graph has a negative gradient <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>
	Total	6	

Question	Answer	Marks	Guidance
11 (a)	<p>conventional cars have the highest CO₂ emissions as (all) the CO₂ is released directly / the fuel is burnt in the car (1)</p> <p>electric cars have the lowest CO₂ emissions as they do not produce (any) CO₂ directly / use electricity produced by power stations (which makes less CO₂) (1)</p> <p>hybrid cars produce less CO₂ than conventional / more CO₂ than electric cars as some CO₂ is produced directly and some is produced by the power stations(1)</p> <p>idea that bio-fuels only release CO₂ that has been removed from the air by photosynthesis /plants (1)</p>	4	<p>must be clear that fuel is used in the car allow CO₂ produced when the car is in use / at the point of use ignore runs on fossil fuels / relies on fossil fuels / uses fossil fuels</p> <p>ignore no fossil fuels are burnt / used</p> <p>allow pollution for CO₂</p>
	(b)	3	<p>allow named examples eg stopping and starting many times during a journey / amount of traffic(1)</p> <p>allow weight / number of passengers / luggage ignore size of car allow roof box if explained by aerodynamics / window open</p> <p>ignore rain / snow</p> <p>ignore age of car</p>
	Total	7	

Question			Answer	Marks	Guidance
12	(a)	(i)	103.6 (m) (1)	1	
		(ii)	doubling the speed = four times the braking distance / 4 X 39.5 = 158 (2) but braking distance / stopping distance would be very large (1)	2	ignore it takes a long time to stop allow figure of over 150
	(b)		Benefit: (idea that) tyre needs to be replaced at longer intervals / less often (1) Reducing risk: idea of (electronic) sensor or (built in) indicator / need to check the tyre more often (once it reaches 4mm) / check tyres more regularly / replace the tyre once it reaches 4mm / carry out further studies to produce a tyre that has linear (long lasting) wear (1)	2	allow lasts longer / wears more slowly / wont wear as fast ignore tyre won't wear down / tyre more resistant to wear
			Total	5	

Question		Answer	Marks	Guidance
13	(a)	reaches terminal speed when weight (of David) equals drag (1) when parachute opens (there is more drag so) the forces are balanced at lower speed (1)	2	ignore upthrust / allow air resistance / air friction instead of drag if no other marks awarded allow (terminal) speed is slower than before for one mark
	(b)	(idea that) the value of g increases (very slightly) (1)	1	not g increases rapidly
Total			3	

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