GCSE

Additional Science B

General Certificate of Secondary Education

Unit **B721/02:** Modules B3, C3, P3 (Higher Tier)

Mark Scheme for January 2013

Oxford Cambridge and RSA Examinations

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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
BOD	benefit of the doubt
NBOD	benefit of the doubt **not** given
ECF	error carried forward
∧	information omitted
I	ignore
R	reject
CON	contradiction
L1	Level 1
L2	Level 2
L3	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
__	=	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)		cross-country skiers **use** both their arms and legs (to move around) (1) 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)	2	**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 **ignore** runners use their legs / runners use their legs more **allow** runners only need an increase supply of energy in legs **ignore** make energy / produce energy
	(b)	(i)	anaerobic respiration does not require oxygen (1)	1	**ignore** they do not use oxygen / use little oxygen
		(ii)	60 = 2 marks but indication of resting rate of 50 **and** maximum rate of 200 = 1	2	**allow** 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	**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 VO_2 Max by 5 **allow** ECF from b) ii)
	(c)	(i)	(left and right) atria (1)	1	**allow** atrium / auricle
		(ii)	percentage in the sample (13 out of 78 / 16.7%) is similar to the percentage in the whole population / 15% (1)	1	**answer must have a comparison** **ignore** same **number** in the sample as in the population **allow** 15% of 78 is close to 13 **allow** 15% of whole population have fibrillation **and** haven't skied
			Total	8	

Question			Answer	Marks	Guidance
2			**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. **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. **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. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades D to A** **Relevant points include:** **Embryonic v Adult stem cells:** • 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 **Why are they useful:** • 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. **What stem cells are:** • Stem cells are undifferentiated / Can form other types of cells Use the L1, L2, L3 annotations in scoris. Do not use ticks.
			Total	**6**	

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

Question			Answer	Marks	Guidance
4	(a)		mitosis (1)	1	**not** meitosis
	(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)		83.1 (%) scores (2) if answer incorrect for one mark: $\dfrac{180 \times 100}{216.5}$ or $\dfrac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all products}}$ or $\dfrac{M_r \text{ of desired products} \times 100}{\text{sum of } M_r \text{ of all reactants}}$ or $\dfrac{180 \times 100}{138 + 78.5}$ or $\dfrac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}}$ or $\dfrac{180}{138 + 78.5}$ or $\dfrac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}}$ or $\dfrac{180}{180 + 36.5}$	2	**allow** 83 / any number of decimal places if rounded correctly eg 83.141 (2) but if rounded incorrectly eg 83.140 (1)
	(b)		**any two from:** idea of reduce production of unwanted products / ORA (1) idea of making the process (more) sustainable (1) maximise profit (1)	2	**allow** to make only wanted products / less waste product **ignore** reduce waste reactants **ignore** reduce waste unqualified **ignore** references to the environment **ignore** unqualified references to cost **allow** qualified reference to cost eg it costs less for raw materials / cost less in disposing waste **allow** help profits

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

Question			Answer	Marks	Guidance
7				6	**This question is targeted at grades D to A***
			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. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Answer includes a description of the method **and** one step in each calculation is correct. **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. **Level 1 (1–2 marks)** Answer includes a limited description of the method **or** one step in each calculation is correct. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.		**Relevant points at level 3 include:** • 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). **Relevant points at level 2 include:** • 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 ^{o}C) • fuel **C** calculated as 21000 (J / g) and fuel **B** calculated as 13125 (J / g). **Relevant points at level 1 include:** • 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 ^{o}C) • each energy change [B is 10500 (J) and C is 8400 (J)] . Use the L1, L2, L3 annotations in scoris. Do not use ticks.
		`	**Total**	**6**	

Question			Answer	Marks	Guidance
8	(a)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ 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 $MG + 2HCl \rightarrow MgCl2 + H^2$ **not** and or & for + **allow** = instead of $\rightarrow$ **allow** correct multiples eg $2Mg + 4HCl \rightarrow 2MgCl_2 + 2H_2$
	(b)	(i)	106 (cm^3)	1	
		(ii)	2.5 cm^3 / s scores (2) but if answer incorrect then $\underline{50}$ 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) $\underline{49}$ to $\underline{51}$ (1) 20 20
	(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			**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. **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. **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. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted up to grade C** **Relevant points at level 3 include:** • 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). Need a correct calculation or time references in comparisons **Relevant points at level 1 and 2 include:** • 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 if answer only contains information about shape of graph then limited to level one Use the L1, L2, L3 annotations in scoris. Do not use ticks.
			Total	**6**	

Question			Answer	Marks	Guidance
11	(a)		conventional cars have the **highest** CO_2 emissions **as** (all) the CO_2 is released directly / the fuel is burnt in the car (1)	4	must be clear that fuel is used in the car **allow** CO_2 produced when the car is in use / at the point of use **ignore** runs on fossil fuels / relies on fossil fuels / uses fossil fuels
			electric cars have the **lowest** CO_2 emissions **as** they do not produce (any) CO_2 directly / use electricity produced by power stations (which makes less CO_2) (1)		**ignore** no fossil fuels are burnt / used
			hybrid cars produce **less** CO_2 than conventional / more CO_2 than electric cars **as** some CO_2 is produced directly and some is produced by the power stations(1)		
			idea that bio-fuels only release CO_2 that has been removed from the air by photosynthesis /plants (1)		**allow** pollution for CO_2
	(b)		**any three from:** driving styles (1)	3	**allow** named examples eg stopping and starting many times during a journey / amount of traffic(1)
			speeds (1) mass (1)		**allow** weight / number of passengers / luggage **ignore** size of car **allow** roof box if explained by aerodynamics / window open
			idea of aerodynamic shape (1) gradients (1) wind (1) tyre conditions / tyre pressure (1)		**ignore** rain / snow
			type of fuel (1)		
			engine size (1) use of electrical equipment (1)		
					ignore age of car
			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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