OCR
Oxford Cambridge and RSA

GCSE

Additional Science B

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

General Certificate of Secondary Education

Mark Scheme for June 2015

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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.

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

ADDITIONAL OBJECTS: You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

When you open the script if the message appears that there are additional objects you must check these additional objects.

The additional objects are normally additional sheets of answers that must be marked. You should immediately link each extra answer with the appropriate question using the paper clip icon.

PLEASE ASK YOUR TEAM LEADER IF YOU DO NOT KNOW HOW TO DO THIS.

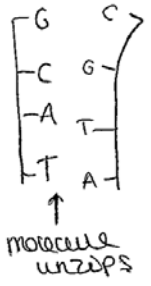
It is vitally important that all parts of the candidate's answer are marked.

Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/	=	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 i	no (no marks) **correct calculation** (heart rate is) 65% (1) **explanation** (idea that it is) less than 80% (1) **but** 65% is less than 80% / it is **only** 65% / it is 15% less (2)	2	**if yes then no marks** **allow** (80% of 200 is) 160 (1) **allow** 130 is less / it is **only** 130 (1) **allow** 130 is less than 160 (2) **if no other mark awarded allow** $\frac{130}{200}$ (x 100) (1)
a ii	**any two from:** (build-up of) lactic acid (1) due to lack of oxygen / oxygen debt (1) from the incomplete breakdown of glucose (1)	2	**ignore** tiredness / anaerobic respiration
b i	$6O_2 \rightarrow 6CO_2$ formulae (1) balancing (1)	2	balancing mark is dependent on the correct formulae but **allow** 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. 6O2 $\rightarrow$ 6 CO_2 (1)

Question	Answer	Marks	Guidance
b ii	**any one from:** **increased** respiration (1) **more** energy (provided / released) (1)	1	**answer must be idea of large amount or increased amount** **allow** respire a lot (1) **ignore** just for respiration **allow** more ATP (1) **allow** to release lots of energy /athlete needs a lot of energy (1) **ignore** just to release energy
b iii	**aerobic** respiration (happens for longer) (1) less lactic acid / no lactic acid (1)	2	**ignore** anaerobic respiration will happen for shorter time **ignore** respiration is faster **allow** lactic acid produced slower (1) **as additional marking point** **allow** (oxygen) makes sure all glucose is respired (1) **if no other mark awarded** **allow** they can exercise for longer / do continuous exercise (1) **ignore** improves performance
	Total	9	

Question	Answer	Marks	Guidance
2 a i	27 (cm) **or** 27.5 (cm) **or** 28 (cm) (1)	1	 **allow** 145 – 172.5 (1)
a ii	growth spurt / puberty (1)	1	**allow** rapid growth / growing faster (1) adolescence on its own is not sufficient
b	**any two from:** (DNA) unzips (1) (idea of) **complementary** <u>strands</u> (1) A - T **and** C - G (1)	2	**ignore** references to mitosis **allow** molecule unzips **ignore** DNA uncoils / DNA unravels/ mRNA unzips / cell unzips / DNA splits / chromosomes split **allow** new <u>strands</u> are 'mirror images' with 50% old DNA and 50% new DNA (1) **allow** marks from a diagram e.g.  (2)
	Total	4	

Question	Answer	Marks	Guidance
3 a	**[Level 3]** **Explains the effects of temperature on luciferase AND explains the specificity of enzymes.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **Explains the effects of temperature on luciferase OR explains the specificity of enzymes.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** **Describes the effects of temperature on luciferase AND describes the specificity of enzymes.** Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A.** **<u>Levels 2 and 3</u>** **Indicative scientific points to explain specificity include:** • 'lock and key' mechanism named & explained • **substrate** shape matches (active site of) luciferase only • a different **substrate** shape does not match (active site of) luciferase **allow** correctly labelled diagram showing 'lock' and key' **ignore** only luciferase enzyme catalyses this reaction (in question) **Indicative scientific points to explain effects of temperature include:** • active site changes shape when denatured (so substrate won't fit) • denaturing may start to occur at around 28°C / occurs at any temperature above optimum • lower collision rates at temperatures around 15°C • higher collision rates at temperatures around 27°C **<u>Level 1</u>** **Indicative scientific points to describe specificity include:** • enzymes only work with one substance • enzymes have an active site **Indicative scientific points to describe effects of temperature include:** • rate of reaction increases between 20°C and 26°C • rate of reaction decreases between 26°C and 45°C • optimum temperature quoted as 25°C or 26°C or 27°C • reaction stops at 45°C **allow** rate increase or decrease anywhere within the range given above **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>b</td><td>any three from:

increase in temperature increases the rate or activity (at both times of the year) / ora (1)

(rates are) higher in winter / ora (1)

work better at 25°C / does not work as well at 15°C (1)

the change is greater in summer / ora (1)

difference between summer and winter is greater at 15°C / ora (1)

any use of comparative data (1)</td><td>3</td><td>allow in winter enzyme activity is increased (1)

examples of comparative data

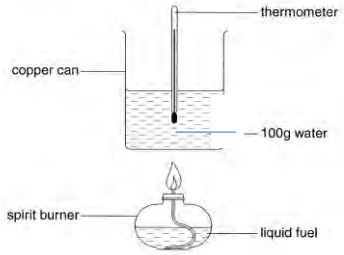
<table><tr><th></th><th>15°C</th><th>25°C</th></tr><tr><td>winter</td><td>2.5</td><td>3.6</td></tr><tr><td>summer</td><td>1.5</td><td>3.0</td></tr></table>
winter at 15°C it is 2.5 but summer it is 1.5 (1)
winter at 25°C it is 3.6 but summer it is 3(.0) (1)
winter at 15°C it is 2.5 but at 25°C it is 3.6 (1)
summer at 15°C it is 1.5 but at 25°C it is 3(.0) (1)</td></tr>
<tr><td></td><td>Total</td><td>9</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
4 a	right ventricle (1)	1	
b	idea that it has to pump blood to the body (not just lungs) (1) idea that it needs to create more pressure (1)	2	**allow** to the body / not **just** to the lungs (1) **allow** has to pump the blood further (1) **ignore** pump more blood **allow** high pressure / a lot of pressure (1) **allow** to develop more force (1) **ignore** under pressure **ignore** reference to left / right
	Total	**3**	

Question	Answer	Marks	Guidance
5 a	$Na_2S_2O_3$ + 2HCl → 2NaCl + SO_2 + S + H_2O formulae (1) balancing (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & balancing mark is dependent on the correct formulae but **allow** 1 mark for a balanced equation with a minor error in subscripts / formulae e.g. Na2S_2O_3 + 2HCL → S + SO2 + 2NaCL + H_2O **allow** HOH for H_2O **allow** NaCl
b	50 (°C) (1)	1	**allow** correct answer ticked, circled or underlined in table if answer line is blank
c	more crowded particles (of thiosulfate) / more particles (of thiosulfate) in the same volume / AW (1) more **frequent** collisions (1)	2	**allow** particles closer together / more particles in the same space / more particles per cm^3 / less space for particles (1) **ignore just** more particles **ignore** more particles in same area **ignore** faster particles **allow** molecules for particles **not** atoms for particles **allow** collisions more often / more chance of a collision / greater rate of collisions / more collisions per second (1) **ignore** faster collisions **if no other mark awarded allow** more (effective/ successful) collisions (1)
d i	16 (minutes) (1)	1	**allow** 13,14 or 15 (1)
d ii	line graph (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
	Total	**7**	

Question	Answer	Marks	Guidance
6 a	different structures of the same **element** **or** different structures of **carbon** (1)	1	**allow** different forms of the same **element** (1) **allow** different forms of **carbon** (1) **allow** different arrangement of carbon atoms (1)
b	(because it is) slippery (1)	1	**allow** weak forces between the layers or sheets (1) **allow** weak bonds between the layers or sheets (1) **not** weak covalent bonds **ignore** (inter)molecular **ignore** weak layers **allow** layers can **slide** over each other / sheets can **slide** over each other (1) **ignore** rub (off)
c	(graphene conducts electricity is related to the presence of) electrons (1) **but** has mobile electrons / delocalised electrons / free electrons / moving electrons (2)	2	**ions, molecules or atoms moving scores 0 for the question** **ignore** reference to bonded electrons **maximum of 1 mark if electrons are positive** **allow** has spare electrons / has loose electrons (2)
	Total	**4**	

Question	Answer	Marks	Guidance
7 a	73 (%) (2) **but if correct answer not given** atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}}$ x 100 (1) **or** atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}}$ x 100 (1) **or** atom economy = $\frac{95}{131}$ x 100 (1)	2	**allow** full marks for correct answer even if equation for atom economy not stated **allow** any correct number of decimal places correctly rounded e.g. 72.5 (%) or 72.519084 (%) (2) **allow** one mark if incorrectly rounded e.g. 72.521 **allow** $\frac{95}{95 + 36}$ x 100 **or** $\frac{95}{95 + (2x18)}$ (1) **allow** where % has not been calculated for 1 mark, e.g. 0.73 (%) (1) **allow** correctly named products / reactants in the atom economy equation
b	**any one from:** makes less **waste** products / more **desired** product made (1) more sustainable or 'greener' (1) to make the process **more** efficient (1) to reduce the processing of unwanted products (1) to conserve raw materials (1)	1	**ignore** references to cost / energy **allow** no **waste** product reduce amount of waste is not sufficient **ignore** more energy efficient **ignore** makes less products / less products wasted **ignore** it wastes less resources
c	endothermic (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
	Total	**4**	

Question	Answer	Marks	Guidance
8 a	**Level 3 (5 – 6 marks)** **Correctly calculates the mass of water used AND describes in detail the experiment.** Quality of written communication does not impede communication of the science at this level. **Level 2 (3 – 4 marks)** **Attempts a calculation AND gives a simple description of the experiment** **OR** **correctly calculates the mass of water used** **OR** **describes in detail the experiment** Quality of written communication partly impedes communication of the science at this level. **Level 1 (1 – 2 marks)** **Attempts a calculation** **OR** **gives a simple description of the experiment.** 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 up to A*** **Indicative scientific points for the calculation may include:** Mass of water calculated from the results from any fuel e.g. mass of water = $\frac{\text{energy}}{\text{SHC x temperature change}}$ = $\frac{7875}{4.2 \times 25}$ = 75g **Indicative scientific points for the experiment may include:** **allow** points from a labelled diagram  • use of a spirit burner / fuel burner (containing liquid fuel) • heat **water** in a copper can / heat **water** in a copper calorimeter / heat **water** in beaker • measuring mass of fuel burned / use a balance • measuring the temperature change of the water / use a thermometer • use same mass or volume or same amount of water / use a measuring cylinder • same distance between spirit burner and copper can or calorimeter or beaker • use same burner each time • use same copper can each time / use same beaker each time • use same size flame or wick **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**

Question	Answer	Marks	Guidance
b	5250 (J/g) (2) **but if correct answer not given** energy per gram = $\frac{\text{energy released}}{\text{mass of fuel burned}}$ (1) **or** $\frac{6300}{1.2}$ (1)	2	**ignore** incorrect units
c	(no) no marks fuel **A** transfers more energy **per gram** (1) fuel **A** transfers 13125 (J/g) (1) **but** fuel **A** transfers 13125 (J/g) but fuel **D** only transfers 8190 (J/g) (2)	2	**if yes then no marks** **allow** fuel **A** increases the temperature more **per gram** (1)
	Total	**10**	

Question	Answer	Marks	Guidance
9 a	boat **A** identified (no marks) **any two from** boat **A** took 20 minutes **or** boat **A** was faster (over the whole race) **or** boat **A** took less time **or** boat **A** always in the lead **or** **A** reached 6800 m first **or** gradients are different (1) boat **B** took 22 minutes (1) extrapolation on graph for **both** boats (1) **but** boat **A** finished 2 minutes ahead of boat **B** / AW (2)	2	**if boat B then no marks** **allow** correct comparison for boat **B**: boat **B** was slower (over the whole race) or boat **B** took more time **or** boa**t B** never in the lead **or** boat **B** did not reach 6800 m first (1)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>b</td><td>[Level 3]
Calculates a gradient for boat A and a gradient for boat B
AND
makes comparisons.
Quality of written communication does not impede communication of the science at this level
(5 – 6 marks)
[Level 2]
Calculates a gradient AND makes a comparison
OR
calculates a gradient for boat A and a gradient for boat B
OR
makes comparisons.
Quality of written communication partly impedes communication of the science at this level
(3 – 4 marks)
[Level 1]
Calculates a gradient
OR
makes a comparison.
Quality of written communication impedes communication of the science at this level
(1 – 2 marks)
[Level 0]
Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</td><td>6</td><td>This question is targeted at grades up to A*
Indicative scientific points for the boat gradients may include:
<table><tr><th></th><th>start of race in m/s</th><th>end of race in m/s</th><th>whole race in m/s</th></tr><tr><td>boat A</td><td>3.33

allow in range 3.2 – 3.5</td><td>6.4

allow in range 6.2 – 6.6</td><td>5.67

allow in range 5.4 – 6.8</td></tr><tr><td>boat B</td><td>1.67

allow in range 1.5 – 1.8</td><td>8.12

allow in range 7.9 – 8.3</td><td>5.18

allow in range 4.9 – 5.3</td></tr></table>
Indicative scientific points for the comparisons may include:
steeper gradient means the boat is going faster
boat A was faster than boat B / A faster overall / A faster up to 1000 m / boat A takes 5 minutes to travel 1000 m and boat B takes 10 minutes to travel 1000 m / boat A travelled twice the distance in the same time over the first 1000 m
boat A and boat B were both slow(er) for the first 1000 m or to start with
boat A was always in front of boat B
both boats went fast(er) after 1000 m
boat B is faster from 1000 m to finish
boat A had a steeper gradient than boat B for the first 1000 m
boat A had a greater speed than boat B for the first 1000 m
boat B had a steeper gradient than boat A for the last 5800m
boat B had a greater speed than boat B for the last 5800m

Use the L1, L2, L3 annotations in scoris.
Do not use ticks.</td></tr>
<tr><td></td><td>Total</td><td>8</td><td></td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>10 a</td><td>yes (no mark)

correct use of data for braking distance
e.g. from 6 (m) to 74 (m) (1)
e.g. as the speed doubles the braking distance (approximately) quadruples (1)

correct use of data for thinking distance
e.g. from 6 (m) to 22 (m) (1)
e.g. as the speed doubles the thinking distance (approximately) doubles (1)</td><td>2</td><td>if no then no marks

<table><tr><th>Speed m/s</th><th>Thinking</th><th>Braking</th></tr><tr><td>9.1</td><td>6</td><td>6</td></tr><tr><td>13.4</td><td>10</td><td>14</td></tr><tr><td>17.9</td><td>12</td><td>24</td></tr><tr><td>22.3</td><td>16</td><td>38</td></tr><tr><td>26.8</td><td>18</td><td>56</td></tr><tr><td>31.3</td><td>22</td><td>74</td></tr></table>
if no data used then allow 1 mark for correct comparison e.g.
braking distance changed more than thinking distance (1)
e.g. after the first one, the braking distance is always bigger (1)</td></tr>
<tr><td>b i</td><td>condition of tyres (1)</td><td>1</td><td>if answer line blank allow correct answer circled or underlined
more than one answer = 0 marks</td></tr>
<tr><td>ii</td><td>

icy road / wet road / smooth road / worn tyres / worn brakes / poor suspension (1)

less grip / less friction (1)

or

heavy vehicle / large vehicle (1)

more force / more weight (1)</td><td>2</td><td>mark points independently

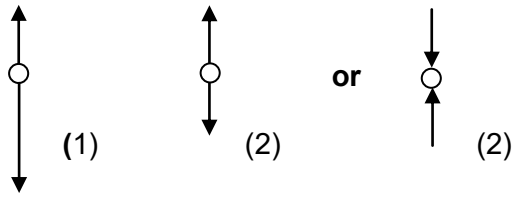
allow leaves on road / gravel on the road / raining /oil on road(1)
ignore just bad weather

allow slippery / hard to grip / hard to stop (1)

allow more momentum (1)</td></tr>
<tr><td>c i</td><td>make the seat belt more comfortable / AW (1)</td><td>1</td><td>allow any way the seatbelt is made more comfortable e.g. make the seat belt padded (1)
ignore other suggestions not in the table e.g. increase awareness</td></tr>
</table>

Question	Answer	Marks	Guidance
ii	**risks** **max one from** (idea that) more comfortable seatbelts may be less effective (1) drivers may still not wear a seatbelt (1) **benefits** **max one from** more likely to wear a seatbelt if it is comfortable (1) (idea that they are) less likely to be seriously injured (in a crash) (1)	2	 **allow** examples e.g. do not stretch / not as secure (1) **ignore just** less safe **ignore** quality **allow** less deaths (1)
	Total	**8**	

Question	Answer	Marks	Guidance
11 a i	17.5 (watts) (2) **but if answer incorrect** $\frac{300 \times 7}{120}$ (1) **or** $\frac{2100}{120}$ (1)	2	
ii	**any 2 from for 1 mark** climb higher (in the same time) more weight / more force (in the same time) climb faster / take less time to climb (to the same height) (1)	1	 **allow** increase distance **allow** more effort **allow** improve her time / increase her speed **if no other mark awarded allow** do more work
b	100 (seconds) (2) **but if answer incorrect** time = $\frac{\text{work done}}{\text{power}}$ **or** time = $\frac{2800}{28}$ (1) he has the most power (1)	2	 **if no other mark awarded** **allow** work done = time x power (1)
	Total	**5**	

Question	Answer	Marks	Guidance
12 a i	does not increase (1)	1	if answer line blank allow correct answer circled or underlined more than one answer = 0 marks
ii	increases **energy** of **air** (particles) (1)	1	**allow energy** goes to **air** (particles) (1) **ignore** just given off as heat **ignore** temperature
b	weight and reaction are equal (1) **or** forces are the same / forces are opposite (1) **but** forces acting on her are balanced (2) **or** forces are equal and opposite / weight and reaction are equal and opposite (2)	2	**if drag or air resistance in answer then zero marks unless it is clear that this happened before she reached the ground and is followed by the correct answer (once on the ground)** **if upthrust mentioned maximum 1 mark** **allow** diagram with equal and opposite length arrows (labels not required) e.g.  (1) (2) **or** (2) **allow** correct arrows on diagram even if figure is lying down **allow** no resultant (force) (2) **allow** forces cancel out (2)
	Total	**4**	

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