OCR
Oxford Cambridge and RSA

GCSE

Additional Science B

Unit **B721/01:** Modules B3, C3, P3 (Foundation 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
	benefit of the doubt
	benefit of the doubt **not** given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	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.

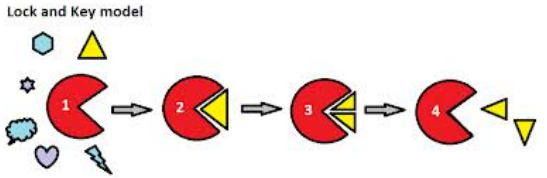
It is vitally important that all parts of the candidate's answer are marked.

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	119 (1)	1	
a ii	**any two from:** (find pulse at) wrist/neck/groin (1) count pulses for 1 minute (1) subject sitting/lying down/relaxed/recovered(1)	2	 **not** using thumb **allow** reasonable length of time scaled to a minute e.g 30s x 2 **allow** heart rate =pulse rate / count the beats **ignore** resting / before exercise
a iii	**any two from:** pulse rate increases with exercise (1) all five have increased pulse rate (during the 5 minutes exercise) (1) but some have increased more than others (1)	2	 **allow** there is variation in the pulse rates
b i	$6CO_2$ (1)	1	**not** 6CO2 wrong use of subscript
b ii	to transport oxygen/ red blood cells transport oxygen (1)	1	**allow** erythrocyte carries oxygen **allow** so oxygen can flow around the body/ to supply oxygen
	Total	7	

Question	Answer	Marks	Guidance
2 a i	11 to 14 (years old)	1	
a ii	he is smaller than a nine year old girl ☐ he is outside the expected range of heights ☑ he should be 130cm tall ☐ he is shorter than the average height of a four year old boy ☐	1	more than 1 tick is zero
b	change(s) in a gene/DNA (1)	1	**allow** different sequence in code/gene/DNA **ignore** changes in chromosomes or cells **ignore** harmful/bad/faulty genes
c	**any two from:** idea that results can be checked / evaluated / validated / need to be proved / see if they have made a mistake (1) so that further evidence can be collected (1) work can be developed further (1) so they can get recognition for their work (1)	2	**allow** to make sure it is correct **allow** to replicate results / improve reliability **allow** help advance
	Total	5	

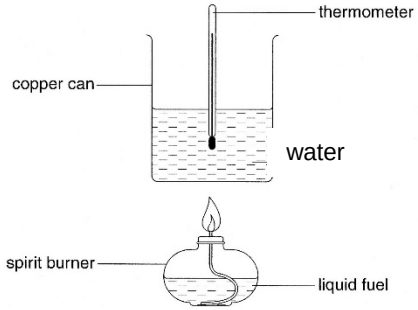
Question	Answer	Marks	Guidance
3 a	**[Level 3]** Includes a full description of the effects of temperature on luciferase **and** includes an explanation about the specificity of enzymes using lock and key ideas. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Includes a full description of the effects of temperature on luciferase **or** includes an explanation about the specificity of enzymes using lock and key ideas. **OR** Gives a partial description of the effects of temperature on luciferase **and** mentions the idea of specificity without mechanism. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Gives a partial description of the effects of temperature on luciferase **or** mentions the idea of specificity without mechanism. 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 C.** **Indicative scientific points explanation of specificity may include:**  • using 'lock and key' (mechanism to explain specificity). • substrate/chemical matches the enzyme • active site / both shapes fit • other chemicals do not match space • in different enzymes the space inside the enzyme do not match **allow** correctly labelled diagram showing 'lock' shape for luciferase and 'key' shape for chemical fitting and other shapes not fitting **Indicative scientific points for full description may include:** • best or optimum temperature is 25-27^{0}C allow any inclusive value • at the start **activity** of luciferase increases as temperature increases • Luciferase activity slows down at higher temperatures • stops working/denatures **at 45^{0}C** • luciferase speeds up the reaction **Indicative scientific points for partial description may include:** • **at the start** as temperature increases the light intensity /brightness increases • peaks • activity/light decreases at higher temperatures • stops working at highest temperatures **Indicative scientific points about the idea of specificity may**

			include: • idea that enzymes are specific • only luciferase can 'join' to the chemical **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**
b	**any three from:** identify / select fireflies with the brightest/longest glowing (1) breed/crossbreed (the brightest fireflies together) (1) select the brightest glowing offspring and breed together (1) repeat over many generations (1)	**3**	**allow** desired traits **allow** bright ones produce flies with the brightest light
	Total	**9**	

Question	Answer	Marks	Guidance
4 a	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
b	idea that the rate the heart pumps the blood can be increased / ORA (1) idea of increase in demand for oxygen / glucose needed (during exercise) ORA (1)	**2**	**allow** otherwise rate won't increase **allow** to get more oxygen **ignore** enough oxygen **ignore** oxygen produced
	Total	**4**	

Question	Answer	Marks	Guidance
5 a	**A** (1)	1	**allow** correct answer ticked, circled or underlined in table if answer line is blank **allow** (concentration at) 43 (seconds)
b	**any two from:** increase concentration of (hydrochloric) acid (1) increase temperature (1) stir / shake (1) add a catalyst (1)]	2	assume **it** refers to thiosulfate **allow** more heat **ignore** references to using a powder / larger surface area **ignore** increase pressure **allow** particles move faster or have more energy (1) **allow** more (frequent or effective) collisions (1)
c	all (hydrochloric) acid used up / all sodium thiosulfate / limiting reactants used up / (1)	1	**allow** (all) reactant(s) used up /ran out **allow** no more chemicals to react **not** they are dissolved
d i	line graph (1)	1	**allow** correct answer ticked, circled or underlined in list if answer line is blank
d ii	(yes because) **then any two from:** reaction with small marble chips finishes first / 16 mins ora (1) more mass is lost in the first 4 minutes with small marble chips / ora (1) smaller chips have more surface area (1)	2	**marks are for explanation** **no = zero** **assume unqualified answer refers to small marble chips** **allow** more mass is lost with small marble chips in any correct time period e.g. first 8 minutes (1) **allow** more mass is lost at the start of the reaction with small marble chips (1) **allow** any two times correctly compared (1)
	Total	**7**	

Question	Answer	Marks	Guidance
6 a	diamond (1)	1	
b	**any one from:** black (1) lustrous / shiny (1) slippery (1) insoluble (in water) (1) conducts (electricity) (1)	1	**allow** it's a dark colour **allow** layers can slide over each other easily **allow** layers can slide off onto paper **allow** it can leave marks on the paper **allow** high melting point / high boiling point **allow** semi-conductor
c	**any two from:** idea that fullerenes can act as (hollow) cages to trap other molecules (1) idea that fullerenes can carry drug (molecules) around the body (and deliver them to where they are needed) (1) large (internal) surface area (1)	2	 **allow** store drugs inside the fullerene in the body **allow** transport drugs
	Total	**4**	

Question	Answer	Marks	Guidance
7 a		3	**marks can be awarded from a correctly labelled diagram**
	suitable container of water (1)		**allow** (metal) can / calorimeter / beaker / flask **ignore** test-tube / boiling tube
	but container of water above burning fuel in a suitable container (2)		**allow** fuel in a spirit burner / dish **not** Bunsen heating fuel
	thermometer in water / measuring the temperature (change) of the water (1)		**ignore** references to fair testing
b	*(fuel)* ***C*** because it has the largest (temperature) rise or change (1)	1	**correct identification of C and explanation required for mark** **but** calculated so final temp 30^{o} higher than start **not** C because it has the highest temperature of water at the end **allow** reason if all temp differences calculated correctly at the side of the table
c	ethanol + oxygen $\rightarrow$ carbon dioxide + water (1)	1	**allow** = instead of $\rightarrow$ **not** and / & / instead of + **not** if + heat is in the equation **allow** correct formulae but equation does not need to balance e.g. $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$ **allow** mix of correct formulae and words
	Total	**5**	

Question	Answer	Marks	Guidance
8 a	H_2SO_4 / MgO (1)	1	**allow** correct answer ticked, circled or underlined in symbol equation if answer line is blank
b	87% (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 **or** atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}}$ x 100 **or** atom economy = $\frac{120}{138}$ x 100 scores (1)	2	**allow** full marks for correct answer even if equation for atom economy not stated **allow** 86.96% **allow** $\frac{120}{120 + 18}$ x 100 (1) **allow** $\frac{120}{98 + 40}$ x 100 (1)
c	**Level 3 (5 – 6 marks)** correctly calculates the percentage yield of magnesium sulphate **AND** suggests some possible reasons why percentage yield was less than 100%. Quality of written communication does not impede communication of the science at this level. ***Level 2 (3 – 4 marks)*** attempts to calculate the percentage yield of magnesium sulphate **AND** suggests a possible reason why percentage yield was less than 100%. **OR** correctly calculates the percentage yield of magnesium sulfate **OR** suggests some possible reasons why percentage yield was less than 100%.	6	**This question is targeted at grades up to C** **Indicative scientific points may include:** Percentage yield = $\frac{\text{actual yield}}{\text{predicted yield}}$ x100 OR $\frac{\text{am}}{\text{pm}}$ x 100 = $\frac{4.2}{6.0}$ x 100 = 70% Possible reasons why percentage yield is less than 100% • loss in filtration e.g. some solution would soak into the filter paper • loss in evaporation e.g. some product may spit out during evaporation • loss in transferring liquids e.g. some of the solution sticks to the beaker (when it is poured) / spillage • not all the reactants /MgO/acid react to make products • reaction is reversible

Question	Answer	Marks	Guidance
	Quality of written communication partly impedes communication of the science at this level. **Level 1 (1 – 2 marks)** Attempts to calculate the percentage yield of magnesium sulfate **OR** suggests a possible reason why percentage yield was less than 100%. 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.		**Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**
	Total	**9**	

Question	Answer	Marks	Guidance
9 a	correct extension of graph **and** boat **A** identified (1) boat **A** took 20 minutes / boat **A** was faster / boat **A** took less time / boat **A** finished 2 minutes ahead of boat **B** / AW (1)	2	Straight line with same gradient **allow** error of + or – one small square **allow** answer in range 19 – 21 minutes **allow** boat **A** was quicker
b	**[Level 3]** correctly calculates speed in correct units **AND** description of comparisons between boat A and boat B Quality of written communication does not impede communication of the science at this level (5 – 6 marks) **[Level 2]** attempts to calculate speed **AND** basic description of comparisons between boat A and boat B **OR** correctly calculates speed in correct units Quality of written communication partly impedes communication of the science at this level (3 – 4 marks) **[Level 1]** attempts to calculate speed **OR** basic description of comparisons between boat A and boat B 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 C.** **calculation of average speed of boat A may include:** speed = distance/time metres/minute or metres/second or m/s 20 minutes = 20 x 60 = 1200 seconds time = 20 or time = 1200 distance = 6800 m speed = 6800/20 340 m/minute or 5.67 m/s (If no units / incorrect units then classed as level 2 attempt) **allow** 5.66 m/s or any number of decimal places **allow** calculations of speed from candidates extrapolation **comparisons may include:** (overall)boat **A** was faster than boat **B** boat **A** and boat **B** were both slow(er) for the first 1000 m / to start with both boats went fast(er) after 1000 m less than 1000m **A** is faster than **B** after 10 minutes **B** is faster than **A** boat **A** was always in front of boat **B** **allow** correct description of gradients e.g. boat A has a steeper gradient than boat B for the first 10 minutes / at the start **allow** range of 19 to 21 minutes **Use the L1, L2, L3 annotations in scoris.** **Do not use ticks.**
	Total	**8**	

<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

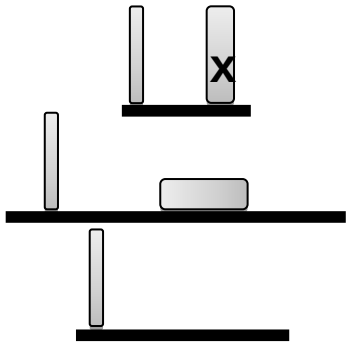
allow leaves on road / gravel on road / raining /oil on road (1)
ignore just bad weather / poor road surface

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

allow more momentum (1)</td></tr>
<tr><td>c</td><td>risks
max 2 from
may not be correctly adjusted (1)</td><td>3</td><td>allow set wrong / too high might strangle</td></tr>
</table>

Question	Answer	Marks	Guidance
	(incorrect adjustment) could cause injury in a crash (1) (idea that) adjusted for main driver but not changed when someone else drives (1) **benefits** **max 2 from** more comfortable / can be adjusted to fit different size people (1) more likely to wear the seat belt (1) gives (better) protection in a crash (1)		**allow** could be trapped inside the car (in an accident) (1) **allow** hold occupant securely /right amount of pressure **allow** bigger/smaller people/ babies etc. **allow** correct answers about the benefits of using seatbelts e.g. keep driver in their seat (1) prevent injury in a crash (1) prevents driver moving forward and impacting the windscreen (1)
	Total	**8**	

Question	Answer	Marks	Guidance
11 a	2100 (joules) (2) **but if answer incorrect** 300 x 7 (1)	2	
b	**any one from** he is the heaviest /heavier (1) he has done (700 x 4 =) 2800 (joules) of work (1)	1	 **allow** weighs more **ignore** he has done it quicker
c i	(Artem's power is 9.72) watts (1)	1	**allow** W **not** kW **allow** Nm/s
c ii	(climb) faster (1)	1	**allow** carry more weight (1) **allow** (climb) quicker **allow** (carry) more weight/ increase weight
	Total	**5**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>12 a</td><td>
<table>
<tr><th></th><th>GPE</th><th>KE</th></tr>
<tr><td>mass</td><td>✓</td><td>✓</td></tr>
<tr><td>position in Earth’s gravitational field</td><td>✓</td><td></td></tr>
<tr><td>speed</td><td></td><td>✓</td></tr>
</table>
(2)</td><td>2</td><td>one mark for each correct column</td></tr>
<tr><td>b</td><td> 

(1)

book with most mass / size and highest / top (shelf)(1)</td><td>2</td><td>X must be on correct book</td></tr>
<tr><td></td><td>Total</td><td>4</td><td></td></tr>
</table>

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