

GCSE

Additional Science B

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

General Certificate of Secondary Education

Mark Scheme for June 2016

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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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Annotations used in scoris

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

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

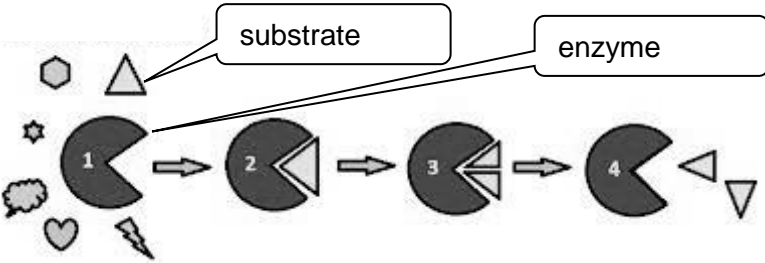
Question	Answer	Marks	Guidance
1 a	any age between 12 to 19 (years of age)	1	
b	any two from: 0-4/5 both similar heights (1) 4/5-9 boys taller / Similar heights at 9 (1) girls taller after 9 (1) boys are (slightly) heavier than/ similar to girls (between range 0 to 10 years) ORA (1)	2	0-4/5 both similar heights then boys grow taller than girls (2) allow growth is similar aged 0-4/5 allow both similar heights but girls shorter between 4/5 and 8 ignore statements after 10 years
c	0 to 2 (years)	1	allow correct answer ticked, ringed or underlined
	Total	4	

Question	Answer	Marks	Guidance
2 a i	114 -162 (2) but (220 - 30 =) 190 (1)	2	
a ii	train more on his swimming / improve swimming technique ideas (1)	1	allow swimming heart rate is too low / swim faster
a iii	any two from: take pulse / how pulse is taken e.g. finger on wrist/neck/groin (1) time for 15 seconds/suitable time to calculate beats per minute (1) record until pulse is back to resting pulse (1)	2	allow take heart rate allow count BPM allow until back to normal heart rate but take the pulse see how long it takes to get back to normal (2)
b	any two from: increased muscle contraction (1) therefore needs more energy (from aerobic respiration) (1) (more energy) to do the extra work (1)	2	answer must be qualitative allow muscles work/used more ignore Mike's doing more exercise allow so energy must come from increased aerobic respiration allow more energy for more work (2) if no other mark then muscles need more oxygen (1)
Total		7	

Question	Answer	Marks	Guidance
3 a i	<p>[Level 3] Must have a comment on the breathing problem or just the idea of inbreeding and identifies two selective breeding points. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Identifies one selective breeding point and suggests one physical characteristic that causes breathing problems</p> <p>or</p> <p>Identifies two selective breeding points. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Identifies one selective breeding point or suggests one physical characteristic (that causes breathing problems). Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to C.</p> <p>Indicative scientific points about breathing problems may include:</p> <ul style="list-style-type: none"> • inbreeding leads to shorter and shorter noses • smaller noses/ reduced nasal passages interferes with breathing • small noses can't clean or heat up air so more chance of infections <p>Indicative scientific points about selective breeding may include:</p> <ul style="list-style-type: none"> • identifies selective breeding / inbreeding as process • wolves/dogs show variation (not dogs from different species) • select desired characteristic /shorter nosed/ short legged wolves/dogs • breed shorter nosed grey wolves together • (keep selecting shorter nosed / short legged characteristic) over many generations / over a long period of time <p>Indicative scientific points about physical characteristic that cause breathing problem</p> <ul style="list-style-type: none"> • small nose / squash nose / shorter nose / upturned nose <p>squashed faces / rolls of skin on face = L1 1</p> <p>Use the L1, L2, L3 annotations in Scoris. Do not use ticks.</p>

Question	Answer	Marks	Guidance
a ii	(a change to) a gene / chromosomes / DNA / sequences of bases (1)	1	allow something that usually makes the gene faulty allow phonetic spelling of gene
b i	39 (1)	1	
b ii	diploid (1)	1	allow correct answer ticked, ringed or underlined
	Total	9	

Question	Answer	Marks	Guidance
4 a i	<p>acid conditions / low pH / pH lower than 7 / (3 drops of) hydrochloric acid / HCl (1)</p> <p>not boiled (1)</p>	2	<p>ignore with (distilled) water</p> <p>allow 'unboiled' (1)</p> <p>allow does not work when boiled (1)</p> <p>allow higher level responses about denaturing (1)</p> <p>ignore at 40 °C / can't be heated / can't be at high temperatures</p> <p>not pepsin is killed at higher temperatures</p>
a ii	<p>any two from</p> <p>(shape of) pepsin or enzyme is a 'lock'(1)</p> <p>the substrate or protein is a 'key' and matches or fits the 'lock' (shape) or pepsin or enzyme (1)</p> <p>other foods like starches will not match or fit the 'lock' (shape) or pepsin or enzyme (1)</p>	2	<p>allow higher level answers e.g. pepsin or enzyme has an active site (1)</p> <p>allow substrate 'locks' onto the pepsin or enzyme (1)</p> <p>allow protein fits into the pepsin or enzyme / protein is specific to the pepsin or enzyme (1)</p> <p>allow egg(-white) as idea of protein</p> <p>ignore enzyme fits into the pepsin</p> <p>allow marking points from labelled diagram</p> <p>'lock' shape labelled pepsin or enzyme (1)</p> <p>'key' shape labelled protein or substrate and shown fitting the 'lock' (1)</p> <p>other foods like starch 'key' shown not fitting the 'lock' (1)</p>

Question	Answer	Marks	Guidance
			 <p style="text-align: right;">(2)</p> <p>if no other mark awarded allow 1 mark for correct unlabelled diagram</p>
b	idea of optimum temperature / works best / close to body temperature (1)	1	<p>allow below 40°C too slow above 40°C denatured</p> <p>not enzyme killed above 40°C</p> <p>allow idea of fair test / fair comparison</p>
Total		5	

Question	Answer	Marks	Guidance
5 a	calcium carbonate + nitric acid → calcium nitrate + carbon dioxide + water (1)	1	allow = instead of → not and / & / instead of + allow correct formulae but equation does not need to balance e.g. $\text{CaCO}_3 + \text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$ allow mix of correct formulae and words
b i	0.52 (g) (1)	1	allow between 0.51 to 0.53g
b ii	<p>between 0 and 1 minute <input checked="" type="checkbox"/></p> <p>between 1 and 2 minutes <input type="checkbox"/></p> <p>between 2 and 3 minutes <input type="checkbox"/></p> <p>between 3 and 4 minutes <input type="checkbox"/></p> <p>(1)</p>	1	
b iii	(no) (mass /volume of) gas made (every minute) decreases/slows down / idea that more gas is made in the first minute than in subsequent minutes (1)	1	no mark for no, mark is for explanation allow two values that indicate the mass every minute is different allow if it was the same the graph would be a straight line
c	all (nitric) acid is used up / all calcium carbonate/marble chips is used up (1)	1	allow all reactant used up allow there was a limiting reactant ignore calcium carbonate has dissolved ignore loses all its reactants/used up all its substance/nothing left to react with

Question	Answer	Marks	Guidance
d	<p>idea that (acid) particles move slower / particles have less energy (1)</p> <p>idea of less(frequent or effective) collisions(between acid and marble chips) (1)</p>	2	<p>assume unqualified answer refers to cold acid allow ora if specified</p> <p>allow fewer collisions ignore slower collisions/vibrate</p> <p>allow higher level answers e.g. collisions between marble chips and acid are less energetic</p>
e	<p>any two from:</p> <p>increase concentration (1) make particles more crowded (1) have more (frequent) collisions (1)</p> <p>use powdered or crushed material (1) use more surface area (1)</p> <p>stir / shake (1)</p> <p>add a catalyst (1)</p>	2	<p>ignore pressure/more acid/more calcium carbonate</p> <p>allow cutting reactant smaller</p> <p>ignore use smaller particles</p>
Total		9	

Question	Answer	Marks	Guidance
6 a	Mg / H ₂ O (1)	1	<p>any incorrect formula is zero</p> <p>allow 2H₂O / Mg + H₂O / Mg + 2H₂O</p> <p>allow correct answer ticked, circled or underlined in equation if answer line is blank</p> <p>ignore magnesium and water</p>
b	energy given out or heat given out (1)	1	<p>allow temperature increase</p> <p>allow heat or energy produced / made / exits / released</p> <p>allow energy or heat is lost (limit of acceptability)</p> <p>ignore gives more energy</p> <p>NOT energy or heat is created</p>
c	B (1) largest temperature rise per minute (1)	2	<p>allow all correct calculations of temperature rise per minute in table (A - 5°/min; B - 6°/min; C - 4°/min; D - 5°/min)</p>
Total		4	

Question	Answer	Marks	Guidance
7 a	<p>any two from:</p> <p>batch process makes small/limited/fixed amounts ora (1)</p> <p>idea that batch makes chemicals on demand ora (1)</p> <p>idea that batch process does not operate 24/7 ora (1)</p> <p>idea that in batch process need to clean the containers between batches (1)</p>	2	<p>allow ora for continuous process</p> <p>allow idea of not as much/certain amount each day/made in groups</p> <p>ignore made in batches / continuous are made continuously</p> <p>allow does not have to be stopped and restarted / is not using a production line / does not carry on until somebody switches the machine</p>
b	<p>any two ideas from</p> <p>long time (1)</p> <p>laws (1)</p> <p>safety (1)</p> <p>research or development (1)</p> <p>raw materials (1)</p> <p>conditions (1)</p> <p>labour (1)</p>	2	<p>allow idea of a long time needed / takes 10 years / can take years to develop / can take years to test a new medicine / its extensive work / time consuming (1)</p> <p>allow strict safety laws must be met / need government approval (1)</p> <p>allow safe to use / make sure it doesn't harm people (1)</p> <p>allow has to be trialled / has to be tested / has to be developed / has to be researched (1)</p> <p>allow supplies may be rare or costly (1)</p> <p>allow specific conditions needs / need high temperatures / need (specialised) equipment (1)</p> <p>allow less automation is possible / high wages / labour intensive / need big team (of scientists) (1)</p>

Question	Answer	Marks	Guidance
c	<p>Level 3 (5 – 6 marks) calculates the percentage yield for method C and identifies D or B and explains which method should be used to make the painkiller. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3 – 4 marks) calculates the percentage yield for method C or identifies D or B and explains which method should be used to make the painkiller. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1 – 2 marks) Identifies which method (either D or B) should be used to make the painkiller with little or no explanation OR attempts to calculate the percentage yield for method C. 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 up to C</p> <p>Indicative scientific points may include:</p> <p>% yield for method C = $\frac{6.9}{11.5} \times 100 = 60\%$</p> <p>Method D should be used to make the painkiller as it has the highest percentage yield and a high atom economy.</p> <ul style="list-style-type: none"> • high/highest percentage yield / 90% • high atom economy / 80% but not highest • high/highest actual mass produced / 12 g / waste is only 1.3 g / less/least waste <p>Method B has the highest atom economy but the lowest percentage yield.</p> <ul style="list-style-type: none"> • high/highest atom economy / 85% • lowest percentage yield / 50% <p>gives an incorrect value in the table and nothing else = L1 1</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
Total		10	

Question	Answer	Marks	Guidance
8	any two from: high melting point (1) insoluble in water (1) lustrous or shiny (1)	2	allow solid
	Total	2	

Question	Answer	Marks	Guidance
9 a	joule [1]	1	allow correct answer circled [1]
b i	300 (J) [2] but if answer incorrect 0.6 x 500 OR 0.15 x 4 x 500 scores [1]	2	allow 0.15 x 500 = 75 (J) [1]
ii	doubled [1]	1	allow increased by 300 (J) or ecf from (b)(i) e.g. 150 allow 600 (J)
c	Thursday [1]	1	more than one answer = 0 allow correct answer indicated in table if answer line blank [1]
	Total	5	

Question	Answer	Marks	Guidance
10	<p>[Level 3] Describes six changes in acceleration / speed. Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] Describes four changes in acceleration / speed. Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] Describes two changes in acceleration / speed.</p> <p>or</p> <p>Describes the shape of the graph Quality of written communication impedes communication of the science at this level (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to C.</p> <p>descriptions of changes in acceleration: accelerating between A and B no acceleration between B and C deceleration between C and D greater acceleration shown by higher gradient / deceleration between C and D is LESS than acceleration between A and B / acceleration time is less than deceleration time</p> <p>descriptions of changes in speed: increasing speed between A and B constant speed between B and C decreasing speed between C and D</p> <p>descriptions of changes in the shape of the graph: positive gradient / line goes up between A and B horizontal line / no gradient / between B and C negative gradient / line goes down between C and D acceleration changes A→B gradient is greater / line is steeper than C→D gradient the speed changes over the journey / speed is not constant for the whole journey</p> <p>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</p>
Total		6	

Question	Answer	Marks	Guidance
11 a i	<p>any two from</p> <p>(use crash test) dummies (1)</p> <p>use sensors / computer simulations / computer models (1)</p> <p>measure or observe the injuries or forces or impact / assess the damage done (1)</p> <p>use the same conditions for all tests (1)</p> <p>carry out the test with and without the seat belt / with different seatbelts (1)</p> <p>idea of questionnaires / surveys(1)</p>	2	<p>allow crash tests (1)</p> <p>allow sensors on (crash test) dummies (2)</p> <p>allow measure or observe the injuries or forces or impact on (crash test) dummies when the car crashes (2)</p> <p>allow named examples of the same conditions e.g. same speed / same car (1) same size dummy (2)</p>
ii	<p>any two from</p> <p>to improve the design (of the seatbelt) (1)</p> <p>so public or scientists or manufacturers know about the tests (1)</p> <p>to compare results / check their results (1)</p> <p>to use the results (for further tests) / to improve (the tests) / to develop (the tests) (1)</p> <p>but</p> <p>so public or scientists or manufacturers can compare the seatbelts / public or scientists can see which is best (2)</p>	2	<p>ignore for publicity / so idea are not stolen / to have the rights / to gain credit</p> <p>allow 'peer review' / try for themselves / for proof / are they right or wrong (1)</p> <p>allow to repeat the test (1)</p>

Question	Answer	Marks	Guidance
b	<p>any one from</p> <p>holds the driver in the seat / restrains the bottom half of the body (1)</p> <p>spreads the force over a larger area (1)</p> <p>can stretch more / can stretch further (1)</p> <p>has stronger anchorage / more anchorage (1)</p>	1	<p>assume answer is about 3-point seat belt unless otherwise stated</p> <p>allow not move around as much / better hold / more secure / more strapped in / supporting in more areas / stops you slipping out (1)</p> <p>allow less pressure / spreads the impact / reduces the impact (1) reduces the force (1) ignore momentum</p> <p>allow stronger / less likely to break (1)</p>
c	<p>(idea that seat belts must have) ability to stretch [1]</p> <p>once seat belts have been in an accident they cannot stretch again [1]</p>	2	<p>allow material must be strong / flexible / expandable / elastic [1]</p> <p>allow higher level answers: e.g. ability to absorb energy [1]</p> <p>allow lose elasticity / lose ability to absorb energy / permanently stretched / overstretched allow the anchorage points / seat belts may be damaged by the accident [1]</p>
d	<p>ABS / traction control / electric windows / (intelligent) cruise control / paddle shift controls / adjustable seats [1]</p>	1	<p>allow any suitable feature but ignore those that protect in an accident e.g. airbags / crumple zones</p>
	Total	8	

Question	Answer	Marks	Guidance
12 a i	to (make it easier to) compare / AW [1]	1	
ii	<p>any two from</p> <p>fuel consumption is more for Model S (as it has a bigger engine / heavier / AW) ora [1]</p> <p>fuel consumption is greater in towns (as changing speed / stopping and starting / AW) ora [1]</p> <p>the combined fuel consumption is a value between the other two (as there are different speeds) [1]</p>	2	<p>ignore references to CO₂ / efficiency</p> <p>allow car R cheaper to run</p>
b	<p>F [1]</p> <p>(anywhere in the range of £)150 → 350 [1]</p>	2	more than one letter no credit for first marking point.
c	slower / less speed / less velocity / ora [1]	1	<p>allow she stops more often [1]</p> <p>allow lower speed limits/cannot go as fast</p>
	Total	6	

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