



GCSE

Additional Science B

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

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.

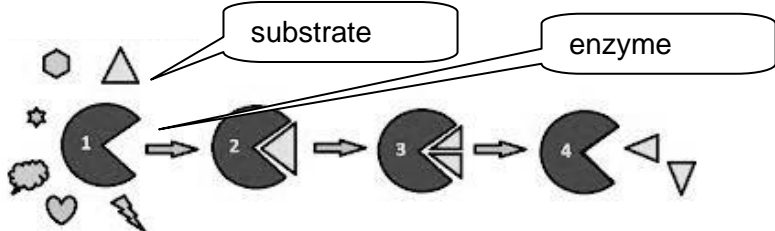
- / = alternative and acceptable answers for the same marking point
- (1) = separates marking points
- allow** = answers that can be accepted
- not** = answers that are not worthy of credit
- reject** = answers that are not worthy of credit
- ignore** = statements that are irrelevant
- () = words that 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	86 (%) (2) but if answer is incorrect or incomplete 191 seen (1)	2	allow 86.4 or 86.39 or 86.387 or 86.3874 or 86.38744 (%) (2)
	a	ii	<p>if answer to (a)(i) is above 85% then</p> <p>above or more than (his target heart rate zone or 85%) / outside (his target heart rate zone) (1)</p> <p>(muscles using) anaerobic (as well as aerobic respiration) (1)</p> <p>if answer to (a)(i) is 60% to 85% then</p> <p>in (his target heart rate zone) (1)</p> <p>(muscles using) aerobic (respiration) (1)</p> <p>if answer to (a)(i) is below 60% then</p> <p>below or less than (his target heart rate zone or 60%) / outside (his target heart rate zone) (1)</p> <p>(muscles using) aerobic (respiration) (1)</p>	2	<p>ignore yes or no</p> <p>allow idea of oxygen debt / incomplete breakdown of glucose / lactic acid build up / (muscle) fatigue (1)</p> <p>allow idea of no oxygen debt / complete breakdown of glucose / no lactic acid build up / no (muscle) fatigue / no anaerobic respiration (1)</p> <p>allow idea of no oxygen debt / complete breakdown of glucose / no lactic acid build up / no (muscle) fatigue / no anaerobic respiration (1)</p>

Question			Answer	Marks	Guidance
	b		<p>haemoglobin combines with oxygen / oxyhaemoglobin (formed) (1)</p> <p>more oxygen so they can respire more or respire quicker / more oxygen so they have more energy / more oxygen so there is less fatigue (1)</p>	2	<p>allow haemoglobin carries oxygen (1) allow haemoglobin transports oxygen (1) allow haemoglobin has a high affinity for oxygen (1)</p> <p>ignore haemoglobin attracts oxygen / haemoglobin makes more room for oxygen / haemoglobin provides oxygen</p> <p>allow more oxygen so they do not need to use anaerobic respiration (as much) (1) allow more oxygen so no or less lactic acid made (1) allow more oxygen so no or less oxygen debt (1)</p>
Total				6	

Question	Answer	Marks	Guidance
2 a	<p>[Level 3] Identifies reasons for breathing problems AND links <u>detailed</u> selective breeding to other health problems. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Identifies reasons for breathing problems AND links selective breeding to other health problems. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Identifies reasons for breathing problems OR links selective breeding to other health 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 A.</p> <p>Indicative scientific points to link selective breeding to other health problems at level 3 (<u>detailed</u>) may include:</p> <ul style="list-style-type: none"> • reduces gene pool • leads to an accumulation of harmful recessive characteristics • reduction in variation <p>ignore no variety / no variation</p> <p>Indicative scientific points to link selective breeding to other health problems at level 1 and 2 may include:</p> <ul style="list-style-type: none"> • select the desired characteristic / select named characteristic e.g. select intelligence • idea that selected characteristic may cause problems e.g. selection for intelligence may also cause aggression • mention of recessive characteristic (being harmful) • idea that characteristics or genes are passed to offspring or future generations <p>allow alleles for genes ignore selection of pug nose or short nose</p> <p>Indicative scientific points to identify breathing problems may include:</p> <ul style="list-style-type: none"> • idea of shorter nose / smaller nose / squashed nose / squashed face / flat face • idea of fat or extra skin around the face / nose area • idea of smaller nasal / air passages • idea of problem of getting enough oxygen or air (to lungs) • risk of infection <p>ignore references to mutations throughout</p> <p>Use the L1, L2, L3 annotations in RM Assessor. Do not use ticks.</p>

Question			Answer	Marks	Guidance
	b	i	meiosis (1)	1	allow phonetic spelling but must not have a 't' in the middle
	b	ii	diploid (1)	1	allow correct answer ticked, ringed or underlined
			Total	8	

Question	Answer	Marks	Guidance
3 a i	acid conditions / low pH / pH lower than 7 / (3 drops of) hydrochloric acid / HCl (1) not boiled (1)	2	ignore with (distilled) water allow 'unboiled' (1) allow does not work when boiled (1) allow higher level responses about denaturing (1) ignore at 40 °C / can't be heated / can't be at high temperatures not pepsin is killed at higher temperatures
a ii	any two from (shape of) pepsin or enzyme is a 'lock'(1) the substrate or protein is a 'key' and matches or fits the 'lock' (shape) or pepsin or enzyme (1) other foods like starches will not match or fit the 'lock' (shape) or pepsin or enzyme (1)	2	allow higher level answers e.g. pepsin or enzyme has an active site (1) allow substrate 'locks' onto the pepsin or enzyme (1) allow protein fits into the pepsin or enzyme / protein is specific to the pepsin or enzyme (1) allow egg(-white) as idea of protein ignore enzyme fits into the pepsin allow marking points from labelled diagram 'lock' shape labelled pepsin or enzyme (1) 'key' shape labelled protein or substrate and shown fitting the 'lock' (1) other foods like starch 'key' shown not fitting the 'lock' (1)  <div style="text-align: right;">(2)</div> if no other mark awarded allow 1 mark for correct unlabelled diagram

Question			Answer	Marks	Guidance
	b		<p>A A G T C</p> <p>(2)</p>	2	<p>all correct (2) three or four correct (1)</p> <p>allow a for A, g for G, t for T and c for C</p>
	c	i	Isoleucine Glycine Aspartic (acid)	2	<p>all three correct and in correct order/place (2) two correct and in correct order/place (1) all three correct but not in the correct order/place (1)</p>
	c	ii	<p>(different order of amino acids or bases) makes a different protein / makes a protein that does not work / makes a protein that does not break down starch / does not make a protein (1)</p> <p>idea that (order of amino acids) determines the shape of the protein / active site (1)</p>	2	<p>allow enzyme for protein allow changes function of protein (1) allow pepsin not made / pepsin would not work (1)</p>
	c	iii	<p>any one from</p> <p>same amino acid / codes for isoleucine / still uses isoleucine (1)</p> <p>TAT and TAA are the same (amino acid) / TAT is isoleucine (1)</p>	1	
			Total	11	

Question			Answer	Marks	Guidance
4	a		$2 (\text{C}_2\text{H}_3\text{O}_2\text{Na}) + \text{CO}_2 + \text{H}_2\text{O}$ formulae for CO_2 and H_2O (1) balancing addition of 2 in front of $(\text{C}_2\text{H}_3\text{O}_2\text{Na})$ and no numbers or the number '1' in front of CO_2 and H_2O (1)	2	allow any order of products ignore spaces between boxes balancing mark is dependent on the correct formulae but allow 1 mark for a balanced equation with minor errors in subscripts / formulae e.g. $2 + \text{Co}_2 + \text{H}_2\text{O}$
	b		3 (minutes) (1)	1	
	c	i	0.45 (g/min) (2) but if incorrect or incomplete <u>0.68</u> (1) 1.5	2	allow 0.453 (g/min) (1) allow 0.5 (g/min) (1)
		ii	gradient or line (at 1.5) is steeper / gradient or line at 4 is less steep (1)	1	assume gradient is at 1.5 unless otherwise stated answer must be comparative allow curve is steeper / becomes less steep (1) ignore just line is less steep

Question	Answer	Marks	Guidance
d	<p>idea that acid particles move slower / (particles have) less energy (1)</p> <p>idea of less frequent collisions (between acid and marble chips) (1)</p> <p>idea of less energetic or less successful or less effective collisions (1)</p>	3	<p>assume answers are about the cold acid unless otherwise specified</p> <p>allow collide less often / less chance of a collision / less likely to collide (1)</p> <p>ignore less collisions</p> <p>ignore slower collisions</p> <p>allow less energetic or less successful or less effective collisions per second (2)</p> <p>If no other mark awarded allow one mark for less collisions (1)</p> <p>but</p> <p>If the candidate has only given details for the hot acid for a particular marking point allow one mark for a maximum of two marks</p> <p>any two from</p> <p>idea that acid particles move faster / (particles have) more energy (1)</p> <p>idea of more frequent collisions (between acid and marble chips) (1)</p> <p>idea of more energetic or more successful or more effective collisions (1)</p> <p>If no other mark awarded allow one mark for more collisions (1)</p>
e	limiting (1)	1	allow limit(ed) (1)
	Total	10	

Question		Answer	Marks	Guidance
5	a	<p>any one from</p> <p>mass of reactants = mass of products (1)</p> <p>$24 + [2 \times 18] = 58 + 2$ (1)</p> <p>$24 + 36 = 58 + 2$ (1)</p>	1	<p>allow mass stays the same on each side (1)</p> <p>allow weight for mass</p> <p>allow $60 = 60$ or $60 \rightarrow 60$ (1)</p> <p>allow both sides of the equation have 1 Mg, 4 H and 2 O (1)</p>
	b	<p>idea that bond breaking is endothermic (1)</p> <p>idea that bond making is exothermic (1)</p> <p>more energy is given out (in bond making) than is taken in (in bond breaking) (1)</p>	3	<p>allow bond breaking absorbs energy / bond breaking needs energy (1)</p> <p>allow heat for energy but ignore references to temperature</p> <p>allow bond making releases energy (1)</p> <p>allow heat for energy but ignore references to temperature</p> <p>allow more energy released than absorbed / more energy released than needed (1)</p> <p>but references to different numbers of bonds, e.g. more bonds made than broken, loses 3rd mark</p> <p>reference to intermolecular bonds scores a max of 2 marks</p> <p>if no other mark awarded</p> <p>allow exothermic reactions give out energy or heat (1)</p>
	c	<p>(D)</p> <p>(heats 227g) by 6 (°C) in a minute (1)</p> <p>but</p> <p>(heats 227g) by 56 (°C) in 9.3 minutes (2)</p>	2	<p>no mark for D, mark is for explanation</p> <p>if A, B or C selected then 0 marks for whole question</p> <p>if no letter given mark answer</p> <p>allow (heats the 227g) by largest temperature rise per minute (1) allow heats the food quicker / in the least amount of time (1)</p> <p>allow heats up by 72 (°C) in 12 minutes (2)</p> <p>allow heats up by 60 (°C) in 10 minutes (2)</p>
		Total	6	

Question		Answer	Marks	Guidance
6	a	<p>any one from</p> <p>idea that most medicines are made in small amounts (1)</p> <p>new batches can be made when the stored medicine runs low (1)</p> <p>if a lot of one medicine is needed then batches can be made at the same time (1)</p> <p>drugs have a 'best before' date so cannot be stored for long (1)</p>	1	<p>allow low demand for some medicines / medicines are made to order / the drug being made can be changed easily / do not need medicines all the time (e.g. hay fever tablets) / if there is a problem then only a small batch is wasted (1)</p> <p>ignore the process can be easily stopped / references to cost / same equipment can be used</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 / it is 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 extraction of materials may be costly / materials may be rare (1)</p> <p>allow specific conditions needed / need high temperatures / need energy / 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] Calculates the percentage yield for method C AND identifies that method D should be used to make the painkiller with <u>detailed</u> explanations. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Calculates the percentage yield for method C AND identifies that method D should be used to make the painkiller with a <u>detailed</u> explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Calculates the percentage yield for method C AND identifies that method B or D should be used to make the painkiller with a <u>limited</u> explanation. 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 to calculate percentage yield for method C may include:</p> <p>% yield for method C = 60 (%)</p> <p>allow 60 (%) in correct place in table</p> <p>Indicative scientific points to identify the method with <u>detailed</u> explanation may include:</p> <p>Method D should be used to make the painkiller as it has</p> <ul style="list-style-type: none"> the highest percentage yield high or second highest atom economy idea that method D is not the cheapest but the extra cost is worthwhile over method B <p>allow correct comparisons in terms of cost e.g. (B is) 6p cheaper but D has a better yield</p> <p>Indicative scientific points to identify the method with <u>limited</u> explanation may include:</p> <p>Method D should be used to make the painkiller as it has any one of the following</p> <ul style="list-style-type: none"> good or high percentage yield good atom economy cheap / not expensive <p>Method B should be used to make the painkiller as it has any one of the following</p> <ul style="list-style-type: none"> highest atom economy cheap(est) <p>Use the L1, L2, L3 annotations in RM Assessor. Do not use ticks.</p>
Total		9	

Question			Answer	Marks	Guidance
7	a	i	300 (J) (3) but if answer incorrect 0.15 x 4 x 50 x 10 (2) or 0.15 x 50 x 10 (1) or 0.15 x 4 x 50 (1)	3	 allow 75 (J) (2) allow '50 x 10' or 500 (1) (i.e. for calculating weight) allow 30 (J) or 3 (J) (2)
	a	ii	any one from idea of friction (1) idea of other forces (1) idea that she moves vertically and horizontally (1)	1	 allow air resistance (1) allow going forward and up (1) allow idea that clothes give her more mass (than 50kg) / she could be carrying something (1)
	b		highest or greatest power because (she walks at the) highest / fastest / quickest speed (2) OR the same amount of work (done) in shortest time (2) OR same amount of work (done) (1)	2	 if no other marks awarded allow highest power or greatest power because power = work/time (1)
Total				6	

Question	Answer	Marks	Guidance
8	<p>[Level 3] <u>Detailed</u> description of change in acceleration AND how to calculate distance. Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] <u>Simple</u> description of acceleration AND how to calculate distance. Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] <u>Simple</u> description of acceleration OR how to calculate distance. 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 A.</p> <p>Need a bullet point from the <u>detailed</u> description of change in acceleration to access level 3</p> <p><u>detailed</u> descriptions of changes in acceleration:</p> <ul style="list-style-type: none"> • A to B non-uniform acceleration • C to D non-uniform deceleration • correct description of the non-uniform acceleration • greater acceleration shown by higher gradient • C to D deceleration takes more time than A to B acceleration <p><u>simple</u> descriptions of acceleration:</p> <ul style="list-style-type: none"> • A to B accelerating / A to B speed increases • B to C no acceleration / B to C constant speed • C to D decelerating / C to D speed decreases <p>calculation of distance:</p> <ul style="list-style-type: none"> • area under the graph / correct description of how to calculate area under B and C (e.g. distance = speed x time) <p>Use the L1, L2, L3 annotations in RM Assessor. Do not use ticks.</p>
	Total	6	

Question			Answer	Marks	Guidance
9	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>
	a	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 / educate the public (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 ideas 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 / reduces the force (1)</p> <p>ignore momentum</p> <p>allow stronger / less likely to break (1)</p>
	c	<p>stretch</p> <p>and</p> <p>so it can change shape / absorb energy / change KE / reduce injuries / not break (under the load) (1)</p>	1	<p>allow elastic for stretch</p> <p>ignore resistant / soft edges / retractable / flexible</p> <p>allow rate of change of momentum smaller (1)</p> <p>allow answers in terms of increasing the time or distance taken for the person to stop moving in an accident</p> <p>e.g. stretches so person slows down over a longer time (1)</p> <p>ignore absorbs impact</p>
	d	<p>risk any one from</p> <p>the seatbelt may slip / be too tight / push against where the baby is (1)</p> <p>the woman or baby may be injured (by the seat belt) in an accident / crash (1)</p> <p>benefit any one from</p> <p>idea that the seat belt protects from injury (1)</p> <p>the seat belt stops the woman or baby from going through the windscreen / holds the woman or baby in the seat (1)</p>	2	<p>ignore just pressure of seat belt</p> <p>allow cause a miscarriage in an accident / crash (1)</p> <p>allow saves the life of the woman or baby in a crash (1)</p> <p>allow stop the woman or baby flying out of seat (1)</p>
		Total	8	

Question			Answer	Marks	Guidance
10	a		<p>any one from</p> <p>road conditions / type of road (1)</p> <p>route (1)</p> <p>mass of driver / passengers (1)</p>	1	<p>ignore differences between different types of car e.g. tyres / mass of car / weight of car / engine size / fuel type</p> <p>ignore just weather but allow named conditions that affect the road surface e.g. ice / rain / loose gravel / wet leaves / oil on road</p> <p>allow terrain / place / time / distance / traffic (1)</p> <p>allow any changes to car e.g. luggage / roof rack / windows down / use of air conditioning / tyre pressure (1)</p>
	b	i	(model S has) higher fuel consumption / uses more fuel (1)	1	<p>allow (model S) has more (starting and) stopping (1)</p> <p>allow (model S has) larger engine (1)</p> <p>ignore traffic / speed</p>
	b	ii	acceleration / speeds may vary (1)	1	allow traffic or starting or stopping / idea of different emissions in town or motorway / idea that data comes from more than one car of each model (1)
	c		<p>idea of doubling speed quadruples KE (1)</p> <p>idea of doubling mass doubles KE (1)</p> <p>but doubling speed and doubling mass makes KE 8 x greater (2)</p>	2	<p>ignore yes or no</p> <p>allow same ideas expressed with equations</p> <p>allow it is 8 times greater (2)</p>
			Total	5	

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