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 2016

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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

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

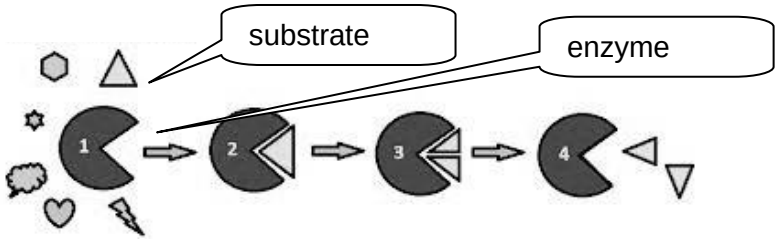
Question			Answer	Marks	Guidance
1	a	i	86 (%) (2) **but if answer is incorrect or incomplete** 191 seen (1)	2	**allow** 86.4 or 86.39 or 86.387 or 86.3874 or 86.38744 (%) (2)

	a	ii	**if answer to (a)(i) is above 85% then**
			
			above or more than (his target heart rate zone or 85%) / outside (his target heart rate zone) (1)
			
			(muscles using) anaerobic (as well as aerobic respiration) (1)
			
			if answer to (a)(i) is 60% to 85% then
			
			in (his target heart rate zone) (1)
			
			(muscles using) aerobic (respiration) (1)
			
			if answer to (a)(i) is below 60% then
			
			below or less than (his target heart rate zone or 60%) / outside (his target heart rate zone) (1)
			
			(muscles using) aerobic (respiration) (1)
				2	**ignore** yes or no
					
					allow idea of oxygen debt / incomplete breakdown of glucose / lactic acid build up / (muscle) fatigue (1)
					
					allow idea of **no** oxygen debt / complete breakdown of glucose / **no** lactic acid build up / **no** (muscle) fatigue / **no** anaerobic respiration (1)
					
					allow idea of **no** oxygen debt / complete breakdown of glucose / **no** lactic acid build up / **no** (muscle) fatigue / **no** anaerobic respiration (1)

Question			Answer	Marks	Guidance
	b		haemoglobin combines with oxygen / oxyhaemoglobin (formed) (1) **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)	**2**	**allow** haemoglobin carries oxygen (1) **allow** haemoglobin transports oxygen (1) **allow** haemoglobin has a high affinity for oxygen (1) **ignore** haemoglobin attracts oxygen / haemoglobin makes more room for oxygen / haemoglobin provides oxygen **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)
			Total	**6**	

Question			Answer	Marks	Guidance
2	a		**[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) **[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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A.** **Indicative scientific points to link selective breeding to other health problems at level 3 (<u>detailed</u>) may include:** • reduces gene pool • leads to an accumulation of **harmful** recessive characteristics • reduction in variation **ignore** no variety / no variation **Indicative scientific points to link selective breeding to other health problems at level 1 and 2 may include:** • 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 **allow** alleles for genes **ignore** selection of pug nose or short nose **Indicative scientific points to identify breathing problems may include:** • 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 **ignore** references to mutations throughout **Use the L1, L2, L3 annotations in RM Assessor.** **Do not use ticks.**

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)  (2) **if no other mark awarded allow 1 mark for correct unlabelled diagram**

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

Question			Answer	Marks	Guidance
4	a		2 ($C_2H_3O_2Na$) + CO_2 + H_2O **formulae** for CO_2 **and** H_2O (1) **balancing** addition of 2 in front of ($C_2H_3O_2Na$) 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 + Co_2 + H2O
	b		3 (minutes) (1)	1	
	c	i	0.45 (g/min) (2) **but if incorrect or incomplete** $\frac{0.68}{1.5}$ (1)	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		idea that acid particles move slower / (particles have) less energy (1) idea of less frequent collisions (between acid and marble chips) (1) idea of less energetic or less successful or less effective collisions (1)	3	**assume answers are about the cold acid unless otherwise specified** **allow** collide less often / less chance of a collision / less likely to collide (1) **ignore** less collisions **ignore** slower collisions **allow** less energetic or less successful or less effective collisions per second (2) **If no other mark awarded allow one mark for** less collisions (1) **but** **If the candidate has only given details for the hot acid for a particular marking point allow ora for a maximum of two marks** **any two from** idea that acid particles move faster / (particles have) more energy (1) idea of more frequent collisions (between acid and marble chips) (1) idea of more energetic or more successful or more effective collisions (1) **If no other mark awarded allow one mark for** more collisions (1)
	e		limiting (1)	1	**allow** limit(ed) (1)
			Total	**10**	

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

Question			Answer	Marks	Guidance
6	a		**any one from** idea that most medicines are made in small amounts (1) new batches can be made when the stored medicine runs low (1) if a lot of one medicine is needed then batches can be made at the same time (1) drugs have a 'best before' date so cannot be stored for long (1)	1	**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) **ignore** the process can be easily stopped / references to cost / same equipment can be used
	b		**any two ideas from** long time (1) laws (1) safety (1) research or development (1) raw materials (1) conditions (1) labour (1)	2	**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) **allow** strict safety laws must be met / need government approval (1) **allow** safe to use / make sure it doesn't harm people (1) **allow** has to be trialled / has to be tested / has to be developed / has to be researched (1) **allow** extraction of materials may be costly / materials may be rare (1) **allow** specific conditions needed / need high temperatures / need energy / need (specialised) equipment (1) **allow** less automation is possible / high wages / labour intensive / need big team (of scientists) (1)

Question	Answer	Marks	Guidance
c	**[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) **[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) **[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) **[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 to calculate percentage yield for method C may include:** % yield for method **C** = 60 (%) **allow** 60 (%) in correct place in table **Indicative scientific points to identify the method with <u>detailed</u> explanation may include:** Method **D** should be used to make the painkiller as it has • the high**est** 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** **allow** correct comparisons in terms of cost e.g. (**B** is) 6p cheaper but **D** has a better yield **Indicative scientific points to identify the method with <u>limited</u> explanation may include:** Method **D** should be used to make the painkiller as it has any one of the following • good or high percentage yield • good atom economy • cheap / not expensive Method **B** should be used to make the painkiller as it has any one of the following • highest atom economy • cheap(est) **Use the L1, L2, L3 annotations in RM Assessor.** **Do not use ticks.**
	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 x10 (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	**[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) **[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) **[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) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A.** **Need a bullet point from the <u>detailed</u> description of change in acceleration to access level 3** **<u>detailed</u> descriptions of changes in acceleration:** • **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 **<u>simple</u> descriptions of acceleration:** • **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 **calculation of distance:** • area under the graph / correct description of how to calculate area **under B and C** (e.g. distance = speed x time) **Use the L1, L2, L3 annotations in RM Assessor.** **Do not use ticks.**
	Total	**6**	

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

Question			Answer	Marks	Guidance
	b		**any one from** holds the driver in the seat / restrains the bottom half of the body (1) spreads the force over a larger area (1) can stretch **more /** can stretch **further** (1) has stronger anchorage / more anchorage (1)	1	**assume answer is about 3-point seat belt unless otherwise stated** **allow** not move around as much / better hold / more secure / more strapped in / supporting in more areas / stops you slipping out (1) **allow** less pressure / spreads the impact / reduces the impact / reduces the force (1) **ignore** momentum **allow** stronger / less likely to break (1)
	c		stretch **and** so it can change shape / absorb energy / change KE / reduce injuries / not break (under the load) (1)	1	**allow** elastic for stretch **ignore** resistant / soft edges / retractable / flexible **allow** rate of change of momentum smaller (1) **allow** answers in terms of increasing the time or distance taken for the person to stop moving in an accident e.g. stretches so person slows down over a longer time (1) **ignore** absorbs impact
	d		**risk any one from** the seatbelt may slip / be too tight / push against where the baby is (1) the woman or baby may be injured (by the seat belt) **in an accident / crash** (1) **benefit any one from** idea that the seat belt protects from injury (1) the seat belt stops the woman or baby from going through the windscreen / holds the woman or baby in the seat (1)	2	**ignore** just pressure of seat belt **allow** cause a miscarriage **in an accident /crash** (1) **allow** saves the life of the woman or baby in a crash (1) **allow** stop the woman or baby flying out of seat (1)
			Total	**8**	

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

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