

GCSE

Additional Science B

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

General Certificate of Secondary Education

Mark Scheme for June 2014

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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.

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Annotations used in scoris

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction

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

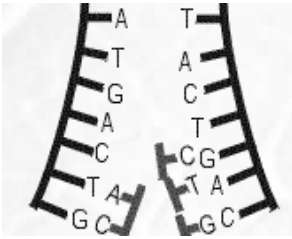
- / = alternative and acceptable answers for the same marking point
- (1) = separates marking points
- allow = answers that can be accepted
- not = answers which are not worthy of credit
- reject = answers which are not worthy of credit
- ignore = statements which are irrelevant
- () = words which are 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 i	A tricuspid (valve) (1) B left atrium (1)	2	allow phonetic spelling allow atrio-ventricular (valve) allow left atria / left auricle
ii	right ventricle has to pump blood a short(er) distance (to lungs) / left ventricle has to pump blood to (rest of / all of) body / left ventricle has to pump blood further (1) so right has less pressure / so right has low(er) pressure / so left has more pressure / so left has high(er) pressure (1)	2	If side of heart not specified, assume 'it' refers to left allow right ventricle does not need to pump blood as far allow if right ventricle had thicker wall the pressure would burst the alveoli allow force for pressure not coping with pressure
b i	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (2) formulae (1) balancing – dependent on correct formulae (1)	2	allow any correct multiple, including fractions allow = instead of \rightarrow not and / & ignore + energy in equation allow 1 mark for a balanced equation with minor errors in subscript, superscript or case e.g. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
ii	any two from: idea that muscles (cells) will not get enough oxygen (1) idea that lactic acid (is produced in muscles)(1) this will causes muscle fatigue / muscle pain (1)	2	maximum of one mark if no reference to muscle ignore oxygen debt not no oxygen allow lactic acid causes muscles to fatigue (2) allow causes cramp (1) allow muscle fatigues due to lack of oxygen (2) allow although muscle not moving still contracting using up energy (1)
c	(ribosomes needed) to make protein (1)	1	allow muscles need protein
	Total	9	

Question	Answer	Marks	Guidance
2 a	<p>any three from:</p> <p>pepsin does not work at pH levels greater than 3.5 / only works at pH below 3.5 (1)</p> <p>intestine pH is outside this range (at 7 to 8) (1)</p> <p>trypsin does not work at pH less than 5.5 / only works between 5.5 and 10 (1)</p> <p>stomach pH is outside this range (at 1 to 2) (1)</p>	3	<p>allow the pH peak of pepsin is within the range 1.5 – 2.0 allow pepsin only work in low(er) pH allow pepsin only works in (strongly) acidic conditions allow pepsin doesn't work at pH 7 or 8</p> <p>allow (idea that) intestine pH is too high / intestine is neutral / intestine is too alkaline</p> <p>allow the pH peak of trypsin is within the range 7.5 – 8.0 / trypsin works in higher pH allow trypsin doesn't work at pH 1 or 2</p> <p>allow (idea that) stomach pH is (too) low / stomach is (too) acidic</p> <p>allow as one extra marking point, higher level responses e.g. correct mention of active site / denaturing / optimum pH (1)</p>
b i	<p>2.1 or 2.13 or 2.125 (2)</p> <p>but</p> <p>$\frac{17}{8}$ (1)</p>	2	<p>if no working out shown; allow 2 (1) allow 2.12 (1)</p>
ii	<p>the reaction is (just over) twice as fast (1)</p>	1	<p>allow ecf from part (i) allow reaction rate doubles ignore just the reaction is faster</p>

Question	Answer	Marks	Guidance
iii	any two from: Idea that enzyme A is not being denatured (1) idea that enzyme A is still working because shape of active site has not changed (1) optimum temperature of enzymes in A must be higher (than B, C and D) (1)	2	allow ora for B,C & D throughout assume 'it' refers to enzyme A ignore references to bacteria having higher optimum temperatures answer must be comparative
Total		8	


Question	Answer	Marks	Guidance
3 a	<p>[Level 3] Isolates one suitable gene AND describes in full the steps in genetic engineering with detailed explanation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Selects one suitable feature / gene AND describes steps in genetic engineering with explanation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Mentions one suitable feature OR describes steps in genetic engineering with limited explanation. OR Describes selective breeding as a method of improving the corn 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 at level 3 may include:</p> <ul style="list-style-type: none"> • isolate named suitable selected gene using enzymes to cut it out e.g. gene for herbicide resistance is cut using enzymes • method of insertion e.g. insert the gene into corn using vector / plasmid / virus <p>Indicative scientific points at level 2 may include:</p> <ul style="list-style-type: none"> • suitable named feature selected / gene e.g. find resistant plant / find resistant gene • explain that gene is isolated • explain that gene is inserted <p>Indicative scientific points at level 1 may include:</p> <ul style="list-style-type: none"> • names a feature e.g. crop resistance / crop does not allow pests to eat it / crop can compete with weeds / crop produces more seeds / crop makes big(ger) seeds / crop grows quick(er) • limited description of selective breeding e.g. choose best plant and use it to produce offspring • limited description of genetic engineering e.g. taking gene or DNA from one organism and transfer it to the corn plant <p>accept all marking points from a clearly labelled diagrams</p> <p>Use the L1, L2, L3 annotations in Scoris. Do not use ticks.</p>

Question	Answer	Marks	Guidance
<p>b</p>	<p>any two from:</p> <p>idea of new strand being formed from (new) bases or nucleotides (using old strand as a template) / new bases or nucleotides are added to the template (1)</p> <p>strands/ bases are complementary (1)</p> <p>(base pairing rules) A-T and C-G (1)</p>	<p>2</p>	<p>allow bases join with bases in the strand</p> <p>allow suitable labelled diagram e.g.</p>  <p>(2)</p> <p>allow shapes instead of A,T,G & C in a diagram (1)</p> <p>allow higher level answer e.g. the method is a semi-conservative replication / new (double) strand has 50% old DNA and 50% new DNA (1)</p>
<p>Total</p>		<p>8</p>	

Question	Answer	Marks	Guidance
4 a	<p>any one from:</p> <p>lustrous (1)</p> <p>colourless (1)</p> <p>clear (1)</p> <p>transparent (1)</p>	1	<p>allow shiny</p> <p>allow sparkly / glistens</p> <p>ignore cost / hard</p>
b	<p>weak (intermolecular) forces between layers (can easily be broken) (1)</p> <p>layers can slide over each other (1)</p>	2	<p>allow has van der Waals forces between layers / weak bonds between layers</p> <p>but weak intermolecular forces on its own is not sufficient</p> <p>allow IMF for intermolecular or VDW for van der Waals forces</p> <p>not weak covalent bonds</p> <p>allow layers are slippery / layers rub off onto paper</p>
c	<p>strong covalent bonds (1)</p> <p>lots of energy needed to break the bonds (1)</p>	2	<p>strong bonds not sufficient</p> <p>covalent on its own not sufficient</p> <p>allow covalent bonds are strong</p> <p>not giant ionic or giant metallic</p> <p>not intermolecular forces</p> <p>allow lots of heat needed to break the bonds</p> <p>ignore harder to break bonds</p> <p>ignore more heat needed to break bonds</p> <p>ignore high temperature</p> <p>not lots of energy needed to break ionic or metallic bonds</p>
	Total	5	

Question	Answer	Marks	Guidance
5 a	<p>40 (°C) (2)</p> <p>but if temperature incorrect</p> <p>temperature change = $\frac{7560}{4.2 \times 100}$</p> <p>or</p> <p>temperature change = $\frac{7560}{420}$</p> <p>or</p> <p>temperature change = $\frac{\text{energy}}{\text{specific heat capacity} \times \text{mass}}$.</p> <p>or</p> <p>temperature change = 18 (°C) (1)</p>	2	<p>look for correct answer first</p> <p>ignore sign (+-) so -40°C (1)</p> <p>answer on answer line takes precedence but also look at the table for possible credit</p> <p>ignore sign (+-) so -18°C (1)</p>
b i	absorbed (1)	1	allow other ways of showing answer e.g. word ticked or circled but answer in sentence takes precedence
ii	exothermic (1)	1	allow other ways of showing answer e.g. word ticked or circled but answer in sentence takes precedence
	Total	4	

Question	Answer	Marks	Guidance
6 a	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ formulae (1) balancing – dependent on correct formulae (1)	2	<p>allow any correct multiple, including fractions</p> <p>allow = / \rightleftharpoons instead of \rightarrow</p> <p>not and / &</p> <p>allow 1 mark for a balanced equation with minor errors in subscript, superscript or case e.g. $\text{CaCO}_3 + 2\text{HCL} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$</p>
b	<p>any one from:</p> <p>reactant not in excess (1)</p> <p>reactant that is all used up (at the end of the reaction) (1)</p> <p>reactant that is used up (first) (1)</p>	1	<p>allow (idea that) it is the reactant that determines the amount of product made</p> <p>allow substance that is used up</p> <p>do not allow product that is used up</p> <p>allow reactant will run out (first)</p> <p>ignore reactant is finite</p>

Question	Answer	Marks	Guidance
<p> c</p>	<p>[Level 3] Analyses the data to explain why Chris has made a correct conclusion AND Answer applies a detailed understanding of the reacting particle model. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Explains quantitatively why Chris has made a correct conclusion AND Answer applies an understanding of the reacting particle model Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Explains why Chris has made a correct conclusion OR Answer applies a basic understanding of the reacting particle model. 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>	<p>6</p>	<p>This question is targeted at grades up to A* allow ora throughout e.g when temp is halved, rate is quartered</p> <p>Level 3 indicative scientific points may include: to explain that Chris is correct;</p> <ul style="list-style-type: none"> • when the concentration doubles the rate doubles but when the temperature doubles the rate quadruples <p>to show the reacting particle model; idea that when the temperature is higher;</p> <ul style="list-style-type: none"> • there are more frequent successful collisions / the collisions are more frequent and more of the collisions are successful / higher chance of successful collisions / increased rate of successful collisions <p>allow more energetic collisions (for successful)</p> <p>Level 2 indicative scientific points may include: to explain that Chris is correct; idea that when the temperature is higher;</p> <ul style="list-style-type: none"> • when the temperature doubles the rate quadruples • when the concentration doubles the rate doubles <p>to show the reacting particle model;</p> <ul style="list-style-type: none"> • particles have more (kinetic) energy • more chance of collision / increased collision frequency / collisions more often • more successful collisions <p>Level 1 indicative scientific points may include: to explain that Chris is correct;</p> <ul style="list-style-type: none"> • as temperature increases the rate increases • as concentration increases the rate increases <p>to show the reacting particle model:</p> <ul style="list-style-type: none"> • the particles move faster • there are more collisions

Question	Answer	Marks	Guidance
			ignore faster collisions / quicker collisions Use the L1, L2, L3 annotations in Scoris; do not use ticks.
	Total	9	

Question	Answer	Marks	Guidance
7 a	75 (%) (2) BUT if correct answer not given, atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all products}} \times 100$ (1) or atom economy = $\frac{180}{240} \times 100$ scores (1) atom economy = $\frac{180}{60+180} \times 100$ scores (1)	2	allow full marks for correct answer even if equation for atom economy not stated allow atom economy = $\frac{M_r \text{ of desired products}}{\text{sum of } M_r \text{ of all reactants}} \times 100$ or atom economy = $\frac{180}{138+102} \times 100$ scores (1)
b	any one from: to make the process (more) sustainable (1) to make the process more efficient (1) to reduce the processing of unwanted products (1) to conserve (raw) materials (1) less waste product (1)	1	ignore references to energy ignore more product is made and less is wasted allow to avoid wasting resources ignore just less waste ignore less product is wasted
c	batch C (1) any one from: C is just below real melting point (1) C is not a range / C is a precise number (1) the more impure a substance the lower its melting point (1)	2	allow 134 allow C is close(st) to real melting point (1) allow C is an exact / C is a definite number (1)

Question	Answer	Marks	Guidance
d i	$[2 \times 27] + [3 \times 32] + [12 \times 16] (= 342) (1)$	1	<p>answer is for the working out not the answer</p> <p>allow correct working out e.g. $54 + 96 + 192 (= 342)$</p> <p>allow $[2 \times 27] + [3 \times 96] (= 342)$</p> <p>allow $54 + 288 (= 342)$</p> <p>allow $27_2 (32 + 16_4)_3$</p>
d ii	<p>any one from:</p> <p>$[2 \times 78] + [3 \times 98] = 342 + [6 \times 18] (1)$</p> <p>$156 + 294 = 342 + 108 (1)$</p> <p>$450 = 450 (1)$</p>	1	<p>allow correct numbers to show that mass of the reactants equals mass of the products</p>
Total		7	

Question	Answer	Marks	Guidance
8 a i	<p>any two from:</p> <p>wet / icy / rain (on road) / snow (on road) / leaves (on road) / slippery road surface (1)</p> <p>increased mass / load (1)</p> <p>faulty brakes / poor brakes (1)</p>	2	<p>ignore (poor) weather / poor road condition</p> <p>ignore reference to ABS</p> <p>as an extra marking point allow old tyres / poor tyres (limit of acceptability) / bald tyres / low tread tyres / poor grip on tyres (1) but ignore bad tyres</p> <p>ignore speed (it is in the question)</p>

Question	Answer	Marks	Guidance
ii	<p>any one from:</p> <p>alcohol (1)</p> <p>drugs (1)</p> <p>tiredness (1)</p> <p>illness (1)</p> <p>concentration (1)</p> <p>distractions (1)</p> <p>age (1)</p> <p>reaction time(1)</p>	1	<p>ignore weather conditions</p> <p>allow examples of distraction / no distraction e.g. children crying / radio / mobile phone (1)</p>
b	<p>thinking distance doubles (1)</p> <p>braking distance quadruples / increases by a factor of four (1)</p>	2	<p>If no other mark achieved allow the idea that thinking distance and braking distance both increases (1)</p>
c	<p>(idea that it) takes less distance to stop / shorter stopping distance (when driving slower) (1) / ora</p>	1	<p>allow shorter braking distance (1) ora</p> <p>allow less likely to skid / lose control of the car (1) ora</p>
	Total	6	

Question	Answer	Marks	Guidance
9	<p>[Level 3] Describes simple changes in GPE using equations to illustrate the answers AND Describes simple changes in KE using equations to illustrate the answers AND describes what happens to GPE when mass is doubled AND describes what happens to KE when mass is doubled Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p>[Level 2] Describes simple changes in GPE AND Describes simple changes in KE AND Uses both equations to illustrate the answers Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p>[Level 1] Describes one simple change in GPE AND Describes one simple change in KE 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. Level 3 is only awarded when description includes information about what happens when mass is doubled</p> <p>descriptions of changes in GPE and KE when mass is doubled may include:</p> <ul style="list-style-type: none"> • doubling the mass of the ball doubles the GPE • GPE is proportional to mass • doubling the mass of the ball doubles the KE • KE is proportional to mass • Idea that the energy transfers remain the same <p>descriptions of changes in GPE and KE using equations may include:</p> <ul style="list-style-type: none"> • equation for GPE = mgh • GPE depends on height • so the higher the ball the more GPE it has • equation for KE = $\frac{1}{2}mv^2$ • KE depends on velocity / KE depends on speed • so the faster the ball the more KE it has • when the ball is not moving (the v is 0 so) the KE is 0 • the total KE + GPE is constant • the total KE + GPE is 100 J for any position <p>descriptions of changes in GPE and KE as the ball falls may include:</p> <ul style="list-style-type: none"> • GPE decreases / allow goes to 0 (J) • GPE decreases from 100 J to 20 J • GPE decreases by 80 J • KE increases / allow goes to 100J • KE increases from 0J to 80J • KE increases by 80 J <p>At level 1 if no other marks awarded allow one mark for a correct equation</p>

Question	Answer	Marks	Guidance
			Use the L1, L2, L3 annotations in scoris. Do not use ticks.
	Total	6	

Question	Answer	Marks	Guidance
10 a	distance (between cameras) divided by time (1)	1	allow $\frac{\text{distance}}{\text{time}}$
b i	8 (m/s) (3) but if answer incorrect $12 + v = \frac{1200 \times 2}{120}$ (2) but if incorrect $1200 = \frac{(12 + v)}{2} \times 120$ (1)	3	if time of 2 minutes used maximum 2 marks
ii	it takes less time (1) but time is half as much / takes one minute (2)	2	
	Total	6	

Question	Answer	Marks	Guidance
11 a	<p>reduce pollution at the point of use (compared to fossil fuel cars) / does not use (fossil) fuels (1)</p> <p>produce pollution or carbon dioxide in their production (1)</p>	2	<p>allow does not produce carbon dioxide at point of use ignore just 'does not produce carbon dioxide emissions' as it is in question allow named fossil fuel e.g. petrol ignore less fuel is used</p> <p>allow production of solar cells / disposal of battery causes pollution (1)</p>
b	<p>any one from:</p> <p>idea of making them more streamlined / aerodynamic to reduce air resistance / to reduce friction / to reduce drag (1)</p> <p>make them as lightweight as possible to reduce the energy required to do work (1)</p> <p>increase the size, number, or orientation of the solar cells to allow more light energy to be used (1)</p> <p>increase the efficiency of the solar cells so greater energy transfer (1)</p> <p>increase the efficiency of the motor so greater energy transfer (1)</p> <p>and</p> <p>any one from:</p> <p>at higher speeds more risk of causing greater injury to the driver / aw (1)</p> <p>making the car lightweight or streamlined may involve removing safety features (1)</p>	2	<p>First marking point requires a feature and a reason</p> <p>allow (idea that) lightweight to increases speed so less protection in the event of a crash (2)</p> <p>allow more solar cells increases the power of the car allow solar panels for solar cells</p> <p>allow at high speed more likely to crash / more likely to lose control of the car</p> <p>allow removal of named safety features e.g. air bags / crumple zones / seat belts</p>

Question	Answer	Marks	Guidance
	benefit to the driver as more likely to win the race / aw (1)		allow examples of benefits to the drivers e.g. able to break speed records ignore goes faster
	Total	4	

Question	Answer	Marks	Guidance
12	<p>F (1)</p> <p>and any one from:</p> <p>they lift the greatest force for the greatest distance (1)</p> <p>the times for lift E and / or F are the shortest / aw (1)</p> <p>as more work is done for lift F than lift E (1)</p> <p>and any one from:</p> <p>(the most powerful lift is) when the rate of doing work is highest (1)</p> <p>(the most powerful lift is) when the work is done in shortest time (1)</p>	3	<p>allow they lift the greatest weight for the greatest distance</p> <p>allow the times for lift E and / or F are the fastest</p> <p>allow correct calculation e.g. 750×1.8 or 1350 (J) is the work done for lift F (1)</p> <p>allow correct calculation e.g. $1350 / 3.6$ or 375 (W) (1)</p> <p>allow 3 marks if the power for (all) the lifts are correctly calculated and compared:</p> <p>A = 33.8 / 34 (W) B = 33.8 / 34 (W) C = 133.9 / 134 (W) D = 136.9 / 137 (W) E = 138.9 / 139 (W) F = 375 (W)</p>
Total		3	

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