

## **GCSE**

### **Additional Science B**

Unit **B722/02**: Modules B4, C4, P4 (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 used in scoris

Annotation	Meaning
	correct response
	incorrect response
<b>BOD</b>	benefit of the doubt
<b>NBOD</b>	benefit of the doubt <b>not</b> given
<b>ECF</b>	error carried forward
	information omitted
<b>I</b>	ignore
<b>R</b>	reject
<b>CON</b>	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

## MARK SCHEME

Question	Answer	Marks	Guidance
1	<pre>graph LR; A[adding sugar] --- B[draws water out of any microorganisms]; C[canning] --- D[stops enzymes working in the microorganisms]; E[freezing] --- D; C --- F[stops microorganisms getting to the berries]; E --- F;</pre>	2	all correct = 2 one or two correct = 1
<b>Total</b>		<b>2</b>	

Question	Answer	Marks	Guidance
2 a i	they feed on dead material / dead trees / dead organisms / decaying matter / detritus / rotting material / decomposing material (1)	1	<b>allow</b> dead animals <b>ignore</b> breaks down dead material etc
ii	<p><b>any three from:</b></p> <p>population is all (the organisms of) one species living in the same habitat (1)</p> <p>community is all the organisms / species / populations living in the same habitat (1)</p> <p>population is all the ash trees or horseshoe bats or thorn moths or woodpeckers (1)</p> <p>community is all the organisms living in the ash woodland (1)</p>	3	<p><b>allow</b> all the same type of organism living in the same area (1) <b>not</b> the number of species</p> <p>need reference to same habitat or area at least once for marking points one or two</p>
iii	<p><b>any two from</b></p> <p>plantation only contains one type of tree (1)</p> <p>idea of less (variety of) habitats (1)</p> <p>idea that less variety of animals can feed from trees / less variety of food for animals (1)</p> <p>(trees often planted closer together so) less light reaches floor of forest (1)</p> <p>fewer other plants can grow (1)</p>	2	<p><b>ignore</b> just affects habitats</p> <p><b>allow</b> idea of disruption of food chains <b>ignore</b> just affects food chains</p> <p><b>ignore</b> decreases biodiversity</p>

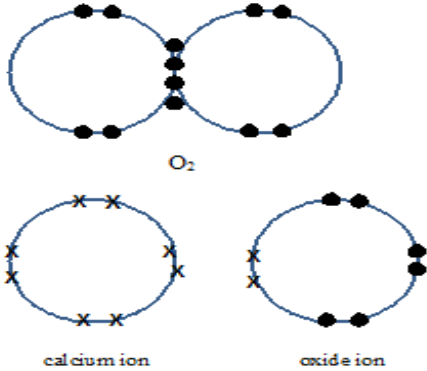
Question	Answer	Marks	Guidance
<b>b</b>	<p><b>first section:</b> less / no water passes up the xylem (1)</p> <p>less / no water reaches the leaves (1)</p> <p>leaves wilt (1)</p> <p><u>guard cells</u> lose water / become flaccid / change shape (1)</p> <p><b>second section:</b> so less carbon dioxide available for photosynthesis (1)</p> <p>less minerals available (to leaves) (1)</p>	4	<p>Marking points must appear in the correct section to score but no limit on each section</p> <p><b>allow</b> idea that it interrupts the transpiration stream</p> <p><b>allow</b> this marking point once only in either section</p> <p><b>ignore</b> shrivels</p> <p><b>ignore</b> reference to respiration but answer must specifically link carbon dioxide to photosynthesis</p>
<b>Total</b>		<b>10</b>	

Question	Answer	Marks	Guidance
3 a	<p><b>[Level 3]</b>            Answer includes an appreciation that photosynthesis and respiration are happening in the light but photosynthesis is faster, so there is net oxygen increase <b>and</b> only respiration occurs in the dark using up oxygen. This is coupled to a quantitative analysis of the results. Quality of written communication does not impede communication of the science at this level.            (5 – 6 marks)</p> <p><b>[Level 2]</b>            Answer includes an appreciation that photosynthesis and respiration are happening in the light <b>and</b> only respiration occurs in the dark using up oxygen. Quality of written communication partly impedes communication of the science at this level.            (3 – 4 marks)</p> <p><b>[Level 1]</b>            Answer includes some understanding of the idea that photosynthesis is happening in the light which causes the increase in oxygen <b>or</b> idea that respiration is happening in the dark which uses up oxygen. Quality of written communication impedes communication of the science at this level.            (1 – 2 marks)</p> <p><b>[Level 0]</b>            Insufficient or irrelevant science. Answer not worthy of credit.            (0 marks)</p>	6	<p><b>This question is targeted from grades to C to A*</b></p> <p><b>Indicative scientific points at level 3 may include:</b></p> <ul style="list-style-type: none"> <li>• Photosynthesis is faster than respiration so oxygen increases</li> <li>• In the clear bottle photosynthesis produces 2mg more oxygen than respiration uses up</li> <li>• In the dark respiration uses up 3mg of oxygen</li> <li>• Therefore photosynthesis makes 5mg of oxygen.</li> </ul> <p><b>Indicative scientific points at level 2 may include:</b></p> <ul style="list-style-type: none"> <li>• In the clear bottle both respiration and photosynthesis are occurring</li> <li>• Only respiration occurs in the dark so oxygen is used up</li> </ul> <p><b>Indicative scientific points at level 1 may include:</b></p> <ul style="list-style-type: none"> <li>• Clear bottle allows light in</li> <li>• Photosynthesis needs light to occur and releases oxygen</li> <li>• Oxygen level in the clear bottle rises</li> <li>• Respiration occurs in the dark bottle</li> <li>• This uses up oxygen</li> <li>• Oxygen level in the black bottle drops</li> </ul> <p><b>ignore</b> references to fish</p> <p><b>Use L1, L2 and L3 in RM assessor. Do not use ticks.</b></p>
b	(Magnesium is needed) to make <u>chlorophyll</u> (1)	1	<b>ignore</b> chloroplasts
	<b>Total</b>	<b>7</b>	

Question	Answer	Marks	Guidance
4 a	<p>cows in the barn produce more milk than those in the field (1)</p> <p>this is because they need to move less / lose less energy keeping warm (1)</p>	2	
b	<p>both groups would make equal profit (1)</p> <p>difference in milk production is 60kg / £30 (which is the cost of the extra food) (1)</p>	2	<p><b>Independent marking points</b></p> <p><b>allow</b> barn = £90 and field = £60 (but food for the barn costs £30) (1)</p> <p><b>allow</b> both make £60 (2)</p>
c	<p>any <b>two</b> from</p> <p>they cannot move around much / less exercise (1)</p> <p>lack of stimulation (1)</p> <p>disease may spread / wastes may build up (1)</p> <p>may get aggressive / injure each other (1)</p>	2	<p><b>allow</b> not free to move around / cannot roam freely / confined</p> <p><b>ignore</b> just less freedom</p>
	<b>Total</b>	<b>6</b>	



Question	Answer	Marks	Guidance
5 a	electrons (1)	1	<b>allow</b> correct answer ticked, circled or underlined in list if the answer line is blank or fully crossed out <b>not</b> electron shells
b	<b>any two from:</b> he split the atom (1) discovered the nucleus (which was part of an atom) (1) showed that the nucleus was positive (1) idea that he showed that the atom had (lots of) empty space (1)	2	<b>ignore</b> references to protons and neutrons  <b>allow</b> showed that <b>the atom</b> is not a solid mass
	<b>Total</b>	<b>3</b>	

Question	Answer	Marks	Guidance
6	<p><b>[Level 3]</b> Constructs the balanced symbol equation <b>and</b> draws the 'dot and cross' diagram for O<sub>2</sub> <b>and</b> draws the 'dot and cross' diagram for CaO Quality of written communication does not impede communication of the science at this level (5 – 6 marks)</p> <p><b>[Level 2]</b> Constructs the balanced symbol equation <b>and</b> draws the 'dot and cross' diagram for either O<sub>2</sub> or CaO</p> <p><b>OR</b> Draws the 'dot and cross' diagram for O<sub>2</sub> <b>and</b> draws the 'dot and cross' diagram for CaO Quality of written communication partly impedes communication of the science at this level (3 – 4 marks)</p> <p><b>[Level 1]</b> Constructs the balanced symbol equation <b>OR</b> Describes the bonding in CaO and O<sub>2</sub> <b>OR</b> Describes or draws the 'dot and cross' diagram for O<sub>2</sub> <b>OR</b> Describes or draws the 'dot and cross' diagram for CaO Quality of written communication impedes communication of the science at this level (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>This question is targeted at grades up to A*.</b></p> <p><b>Indicative scientific points at all levels may include:</b></p> <ul style="list-style-type: none"> <li>• Correct 'dot and cross' diagram for oxygen.</li> <li>• Correct electronic structure for Ca<sup>2+</sup></li> <li>• Correct electronic structure for O<sup>2-</sup></li> <li>• <math>2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}</math> or any other correct multiple</li> </ul>  <p>The diagrams show the following structures:</p> <ul style="list-style-type: none"> <li><b>O<sub>2</sub></b>: Two oxygen atoms, each with two shells. The outer shells overlap and contain four electrons (two pairs), representing a covalent bond.</li> <li><b>calcium ion</b>: A single calcium atom with two shells. The outer shell is empty, representing a Ca<sup>2+</sup> ion.</li> <li><b>oxide ion</b>: A single oxygen atom with two shells. The outer shell contains eight electrons (four pairs), representing an O<sup>2-</sup> ion.</li> </ul> <p><b>ignore</b> inner shells</p> <p><b>allow</b> calcium ion outer shell can be shown as empty.</p> <p>No need to show the charge on the ions – this is given in the question but if it is incorrect if the wrong charge is shown</p> <p><b>Relevant points describing the bonding at levels 1 could include</b></p> <ul style="list-style-type: none"> <li>• Calcium oxide is ionic</li> <li>• Oxygen is covalent</li> </ul> <p><b>Use the L1, L2, L3 annotations in scoris. Do not use ticks.</b></p>
<b>Total</b>		<b>6</b>	

Question	Answer	Marks	Guidance
7 a	(yes because)  (potassium gives a) lilac flame (in the flame test) (1)  (iodide because a) pale yellow precipitate (with silver nitrate) (1)	2	<b>no marks for just saying yes – marks are for explanation if no, 0 for question</b>  <b>allow</b> result from test 2 shows that it contains potassium (1)  <b>allow</b> result from test 5 shows that it contains iodide (1) <b>not</b> iodine
b	<b>any three from:</b>  idea of use a (flame test) wire (1)  dip wire into solution / dip wire into solid (1)  put wire or substance into a (blue) (Bunsen) flame (1)  observe the colour of the flame (1)	3	<b>marks can be awarded from a labelled diagram if heating in a test tube / beaker etc scores 0 for question</b>  <b>allow</b> use a wooden splint / spray solution (1)
<b>Total</b>		<b>5</b>	

Question	Answer	Marks	Guidance
8 a	sodium (carbonate) <b>and</b> potassium (carbonate) (1)	1	both needed
bi	0.96 (g) (1)	1	
bii	all metal carbonates (that decomposed) had the same starting mass (1)  idea that this is the least amount of solid left / most mass lost (so the greatest amount of gas produced) (1)	2	<b>allow</b> decomposed the most  lowest mass of solid left in relation to mass of carbonate (2) <b>allow</b> four correct percentage calculations (2)
c	$\text{MnCO}_3 \rightarrow \text{MnO} + \text{CO}_2$ (1)	1	<b>allow</b> any correct multiple <b>not</b> heat in the equation rather than over the equation all formulae must be completely <b>correct</b>
<b>Total</b>		<b>5</b>	

Question	Answer	Marks	Guidance
9 a	material has (very) low resistance (1)	1	<b>allow</b> material has no resistance
b	idea of super-fast electronic circuits / loss free power transmission (1)  only work at (very) low temperatures (1)	2	<b>allow</b> idea of less or no heat / energy lost  <b>ignore</b> cannot work at room temperature <b>allow</b> temperature in the range -100 to -273
<b>Total</b>		<b>3</b>	

Question	Answer	Marks	Guidance						
10	<table border="1"> <tr> <td>Number of protons in particle</td> <td><b>26</b> (1)</td> </tr> <tr> <td>Number of electrons in particle</td> <td><b>24</b> (1)</td> </tr> <tr> <td>Number of neutrons in particle</td> <td><b>29</b> (1)</td> </tr> </table>	Number of protons in particle	<b>26</b> (1)	Number of electrons in particle	<b>24</b> (1)	Number of neutrons in particle	<b>29</b> (1)	3	
Number of protons in particle	<b>26</b> (1)								
Number of electrons in particle	<b>24</b> (1)								
Number of neutrons in particle	<b>29</b> (1)								
<b>Total</b>		<b>3</b>							

Question	Answer	Marks	Guidance
11 a	(idea of) electron movement (1)  (correct direction idea) from rod (to cloth) (1)	2	mention of positive electrons or moving ions = 0 marks  <b>accept</b> cloth gains electrons from rod (2)  <b>but</b> electrons move from cloth to rod scores (1) only
b	B (1)	1	<b>mark answer on the line first</b>  <b>allow</b> answer ringed, underlined or ticked on diagram if no answer on the answer line
c	<b>any two ideas from these categories</b>  quicker (1)  more (different) designs can be tested / range of experiments (1)  more expertise in different areas / technology / knowledge / information / evidence / perspective (1)  spread the cost / share equipment (1)	2	<b>allow</b> more likely to find a solution  <b>allow</b> they can compare results / can check results  <b>not</b> just 'do things differently' <b>allow</b> more ideas  <b>ignore</b> just cheaper
d	<b>any one from</b>  better finish (1)  shadows painted (1)  less paint used / less waste (1)  quicker (1)	1	<b>allow</b> does not drip / even coating (1) <b>ignore</b> it sticks better  <b>allow</b> idea of better penetration of dents or scratches  <b>ignore</b> just cheaper
	<b>Total</b>	<b>6</b>	

Question	Answer	Marks	Guidance
12 a	2.5 ( $\Omega$ ) (2)  <b>but if incorrect</b>  $\frac{5}{2}$ (1)	2	
b	40 (cm) (2)  <b>but if incorrect allow the idea of:</b>  2/5ths of 100 (1) <b>or</b> 0.05 ohms/cm (1)	2	
c i	3.04 / 3.0 / 3 (2)  <b>but if incorrect</b>  $\frac{700}{230}$ (1)	2	<b>allow</b> 3.04347826 A or any correct rounding (2)
ii	5 A (1)	1	answer dependent on answer in (c)(i) e.g. an answer of 0.33 A is a fuse of 3A answer of 6A is a 10A fuse  If no answer in ci) answer is 5A  <b>mark answer on line first</b> <b>allow</b> answer ringed, underlined or ticked on diagram if no answer on the answer line
	<b>Total</b>	<b>7</b>	

Question	Answer	Marks	Guidance
13	<p><b>[Level 3]</b>            Answer includes a description of a beta particle <b>and</b> describes two or more changes in the nucleus including some reference to atomic number or mass number <b>and</b> constructs fully correct balanced nuclear equation            Quality of written communication does not impede communication of the science at this level            (5 – 6 marks)</p> <p><b>[Level 2]</b>            Answer includes a description of a beta particle <b>and</b> one change in the nucleus  <b>OR</b>            Constructs fully correct balanced nuclear equation            Quality of written communication partly impedes communication of the science at this level            (3 – 4 marks)</p> <p><b>[Level 1]</b>            Answer includes a description of a beta particle  <b>OR</b>            one change in the nucleus  <b>OR</b>            constructs a partially correct balanced nuclear equation            Quality of written communication impedes communication of the science at this level            (1 – 2 marks)</p> <p><b>[Level 0]</b>            Insufficient or irrelevant science. Answer not worthy of credit.            (0 marks)</p>	6	<p><b>This question is targeted up to A*</b></p> <p><b>Indicative scientific points about the Beta particle include</b></p> <ul style="list-style-type: none"> <li>• Beta particle is a high speed / energy electron</li> </ul> <p><b>Indicative scientific points about changes in the nucleus include</b></p> <ul style="list-style-type: none"> <li>• Nucleus gains a proton</li> <li>• Nucleus loses a neutron</li> <li>• Neutron changes to a proton (counts as two changes)</li> <li>• Atomic number increases by one</li> <li>• Mass number unchanged</li> </ul> <p><b>Indicative scientific points involving the balanced nuclear equation</b></p> $  \begin{array}{rcccc}  (14) & & 14 & & 0 \\  & \longrightarrow & & + & \\  (6) & & 7 & & -1  \end{array}  $ <p><b>Use the L1, L2, L3 annotation in Scoris; do not use ticks</b></p>
<b>Total</b>		<b>6</b>	



Question	Answer	Marks	Guidance
14 a	<p>A (1)</p> <p>idea that half-life is time to reduce count rate to half its original value / idea that half-life is time taken to reduce to 3000 (1)</p> <p><b>BUT</b> idea that A reaches half its original value (3000) in a shorter time than the others (2)</p>	3	<p><b>If A not chosen, 0 for question</b></p> <p><b>allow</b> time for activity to halve / time for half the mass of isotope to decay / time for half the atoms or nuclei to decay (1)</p> <p><b>ignore</b> time to give out half the radiation / half of the time taken for the substance to decay</p> <p><b>ignore</b> time for half the atom or nucleus to decay</p> <p><b>ignore</b> just it has the shortest half-life (in stem of question)</p> <p><b>allow</b> detail from the graphs eg reaches half original value                   between 20 and 30 sec for A                                   40 and 50 sec for B                                   60 and 70 sec for C (1)</p> <p><b>allow</b> it has the steepest gradient at the start (1)</p> <p>eg A's activity halves in the shortest time (3)</p> <p><b>ignore</b> faster or quicker time</p>
b i	<p><b>any two from</b></p> <p>C-14 can only be used to date materials that were once living (1)</p> <p>idea that when the plants were living, C-14 levels remain constant (1)</p> <p>idea of C-14 in the plant reducing after plants die (1)</p> <p>idea of comparison of activity in living and dead material / age can be read off a decay curve (1)</p>	2	<p><b>allow</b> idea that all living plants have same amount of C-14 (1)</p> <p><b>allow</b> idea that dead plants do not take in any more C-14 (1)</p>
ii	(idea of) little difference in count rate over 100 years (1)	1	<p><b>allow</b> 100 years is small compared to the half-life of C-14 (1)</p> <p><b>ignore</b> the half-life is too long</p>
	<b>Total</b>	<b>6</b>	

Question	Answer	Marks	Guidance
15 a	<p><b>any three from:</b></p> <p><b>similarities:</b></p> <p>both photosynthesise faster / make sugar faster in summer / named months (1)</p> <p>in October / April rates are equal (1)</p> <p><b>differences:</b></p> <p>deciduous has a higher maximum rate (1)</p> <p>evergreen photosynthesises/ makes sugar throughout the year but deciduous does not / the minimum rate for deciduous tree is lower / deciduous has a faster rate of fall or increase in production (1)</p> <p>correct reference to data for both trees in any marking point (1)</p>	3	<p><b>not</b> makes / produces energy  <b>ignore</b> works better  <b>allow</b> produces energy in sugars  <b>allow</b> traps / stores energy</p> <p><b>allow</b> in summer / named month the rate for deciduous is higher (than the evergreen)</p> <p><b>allow</b> only evergreen photosynthesises / makes sugar in winter / named months  <b>not</b> makes / produces energy  <b>ignore</b> works better</p> <p><b>allow</b> produces energy in sugars  <b>allow</b> traps / stores energy</p> <p>so 1600 max v 1000 max (2)</p>
b i	<p><b>any two from:</b></p> <p>same month / time of the year / both in July (1)</p> <p>same place / area of forest (1)</p> <p>same area of each tree (1)</p>	2	<p><b>ignore</b> same brightness or intensity of sun</p> <p><b>allow</b> same environment / habitat (1)</p>
ii	no, they both trapped 32 000 (1)	1	<b>allow</b> 32000 shown for both on the table

Question	Answer	Marks	Guidance
c i	5(%) (2)  <b>but</b> , if answer incorrect  $1600/32000 \times 100$ (1)	2	allow 0.05 (1)
ii	<b>any two from:</b>  deciduous trees do not photosynthesise / makes sugar in the winter / deciduous trees lose leaves in the winter (1)  but deciduous trees have a higher efficiency (1)  idea that they can photosynthesise / makes more sugar at certain times or idea that they can photosynthesise / makes more sugar in the summer (1)	2	It = deciduous tree  <b>not</b> makes / produces energy / takes in sugar <b>allow</b> produces energy in sugars <b>allow</b> do not make sugar all the year round
<b>Total</b>		<b>10</b>	

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