OCR
Oxford Cambridge and RSA

GCSE

Science B

Unit **B712/02**: Modules B2, C2, P2 (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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning
BP	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
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 i	3750 (2) but if answer incorrect then $\frac{150 \times 100}{4}$ (1)	2	 **allow** $\frac{150}{0.04}$ (1)
b	**eaten** by dung beetles or insects or flies (1) **or** **broken down** by decomposers (1)	1	**ignore** just eaten or eaten by animals **ignore** idea of being used as manure **ignore** eaten by decomposers **allow** decayed **or** broken down by bacteria / fungi / detritivores / saprophytes / microbes / micro-organisms (1) **ignore** decomposers / bacteria use it as a food source **ignore** just they are decomposed **ignore** used by decomposers
	Total	**3**	

Question	Answer	Marks	Guidance
2 a	less lichen closer to factory (1) (suggests they have been) destroyed by (higher levels of) sulfur dioxide (1) **or** the more lichen grow further from factory (1) so the less sulfur dioxide(1)	2	**allow** destroyed by(higher levels) of pollution (1) **allow** lichen can't grow when sulfur dioxide or pollution is present (1) **ignore** references to acid rain **allow** so less pollution (1) **allow** lichen grows in clean air or less polluted air (1) **ignore** sulfur dioxide is poisoning trees **allow as an extra marking point** lichen can be used to measure levels of pollution / are sensitive to sulfur dioxide / lichen are indicator species / lichen likes to live in low pollution area (1)
b	any value greater than or equal to 500 or less than or equal to 800 (1) idea that approximately 25 - 45% of the grid is covered or 25-45 squares contain lichen (1)	2	**2nd mark is conditional on correct value** **allow** idea of estimating or counting the % cover of lichen (1)
c	**any one from:** has not measured the level of sulfur dioxide (at any point) (1) has no results for 100m (1) other acidic gases could be emitted or have an affect (1) idea that it is not a fair comparison because of other factors e.g. moisture, temperature (1)	1	**allow** idea that sulfur dioxide can be dispersed by the wind (1) **allow** would need to use a meter to measure (actual) sulfur dioxide level (1) **ignore** it is just an estimate or approximation

d	**any two from:** bacteria / fungi / decomposers / saprophytes decompose or breakdown or decay leaves (1) ammonia forms (1) nitrifying bacteria (1) convert ammonia to nitrates / nitrites (1)	2	 **allow** microbes / detritivores decompose leaves (1) **allow** nitrifying bacteria decompose leaves scores (1)
	Total	**7**	

Question	Answer	Marks	Guidance
3 a	(thick) fur (1) as it insulates / traps air(1) **or** small ears / short legs (1) reduces surface area or less blood can reach the surface of the ears / legs (1)	2	**allow** reduce energy transfer between animal and surroundings (1) **ignore** hair **ignore** behavioural adaptations such as migration **ignore** traps heat **ignore** references to hooves or counter current exchange system **allow** small surface area to volume ratio (1) **allow** layer of fat (1) which is an insulator (1)
b	**any three from:** contain enzymes with **lower** optimum temperatures (1) the enzymes which work at (very) low temperatures (1) contain antifreeze (1) idea that **cells** do not freeze / freezing would damage **cells** / because (enzyme) reactions need to occur in solution (1)	3	 **allow** photosynthesise at lower temperatures or lower light levels (1) **allow** stops ice crystals forming in **cells** (1) **ignore** larger leaves to absorb more sunlight
	Total	**5**	

Question	Answer	Marks	Guidance
4	**[Level 3** **Suggests two reasons why mynas should be saved AND** **provides a detailed evaluation of the conservation program using appropriate scientific terms.** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Suggests one reason why mynas should be saved AND** **provides a simple evaluation of the conservation program** **OR suggests two reasons why mynas should be saved** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Suggests one reason why mynas should be saved OR** **attempts a simple evaluation of the conservation program** 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 for detailed evaluation at Level 3 may include:** reasons from level 1 plus • population is not **viable** so unlikely to survive • small numbers mean little **genetic variation** within species • isolated population makes it difficult to increase **genetic variation** • small habitat / range so less **resources** for the birds to survive • small habitat makes it easier for the birds to be trapped • as they are bred in captivity may be used to humans and therefore makes them easier to be caught • local people will benefit so may become more protective of the wild population • as the habitat is small it may be easier to police so less trapping may take place. • released bird may still be caught as it is difficult to control illegal trapping / hunting **Indicative scientific points for simple evaluation at Level 1/Level 2 may include:** • unlikely to survive as only few left • could still be hunted when released • mynas released into their natural habitat • already at critical level • only a small habitat so may not be enough food for them • the fact that people will get money means they are more likely to help **Indicative scientific points for reasons may include:** • because the local people could benefit from selling them • idea of preserving cultural tradition • benefits of tourism • protecting food chains • idea of maintaining biodiversity • idea that they could contribute to development of medicines in the future **ignore** human food supply / medical purposes unless qualified **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
	Total	**6**	

Question	Answer	Marks	Guidance
5 a	idea that those with stripes got bitten less / ora(1) idea that striped adaptation passed on to next generation / ora (1)	2	**allow** stripes stop zebras being bitten (1) **allow** flies are attracted to the zebras without stripes and bite them (1) **ignore** ones with no stripes die leaving only stripes **ignore** those without stripes had become more attractive to flies **allow** striped zebras breed giving offspring their characteristics (1) **allow** striped zebras bred and passed on the stripes (1) **allow** (only) zebras with stripes were left so reproduced (1) **allow** those with stripes or not bitten survived and reproduced passing on the gene of stripes (1)
b i	count /compare the number of flies stuck to each zebra (1) **or** less flies on striped model or zebra / ora (1)	1	**allow** measure the mass of flies on each model or zebra (1) **allow** more flies bite models or zebras without stripes (1) **allow** flies less attracted to striped model or zebra / ora (1) **allow** no flies on the striped model or zebra (1) **allow** more complex the pattern the less likely the flies are to stick (1)
b ii	so (other) scientists can gather further evidence / so (other) scientists can investigate ideas further / so they can gain credit or recognition for their work / so work can be checked / to see if work can be replicated / so work does not need to be duplicated / to provide information to or educate the public or other organisations (1)	1	**allow** work can be developed further (1) **allow** to get feedback for improvement (1) **allow** so other scientists cannot take credit (1) **allow** peer review / work can be evaluated (1) **allow** scientists can use the work to back up their own theories (1)
	Total	**4**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6 a</td><td>
<table>
<tr><th>Element</th><th>Number of atoms</th></tr>
<tr><td>nitrogen</td><td>3</td></tr>
<tr><td>hydrogen</td><td>12</td></tr>
<tr><td>phosphorus</td><td>1</td></tr>
<tr><td>oxygen</td><td>4</td></tr>
</table>
N and H correct (1)
P and O correct (1)</td><td>2</td><td></td></tr>
<tr><td>b</td><td>ammonia / ammonium hydroxide (1)

phosphoric acid (1)</td><td>2</td><td>order unimportant

allow NH_3 / NH_4OH (1)
allow ammonium hydrogencarbonate or ammonium carbonate (1)
not ammonium
not ammonia hydroxide or ammonia carbonate or ammonia hydrogencarbonate

allow H_3PO_4 (1)
not phosphorus acid</td></tr>
<tr><td>c</td><td>idea that fertilisers replace or contain essential elements (used by previous crop) / provide extra essential elements (1)

used to build plant protein or peptides or polypeptides or amino acids (1)</td><td>2</td><td>allow provides named essential elements e.g. nitrogen / nitrates, phosphorus/phosphates or potassium (1)
ignore fertilisers contain essential nutrients or essential minerals

nitrogen or nitrates used to build plant protein scores (2)
but if the candidate matches only phosphorus or only potassium to building plant protein this only scores (1)</td></tr>
<tr><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
7 a	$N_2 + 3H_2 \rightarrow 2NH_3$ formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **allow** any correct multiple e.g. $2N_2 + 6H_2 \rightarrow 4NH_3$ (2) **allow** = or ⇆ or ⇌ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $N^2 + 3h_2 \rightarrow 2NH_3$
b	**any four from** catalyst – speeds up reaction (1) catalyst – has no effect on yield (1) high pressure - increases (percentage) yield (of ammonia) (1) high pressure – increases rate of reaction (1) 450^oC – (high temperature) gives reduced yield (of ammonia) (1) 450^oC – (high temperature) gives a high rate of reaction (1)	4	**mark 1st four points** **allow** catalyst reduces activation energy (1) **allow** makes more ammonia (1) **allow (**high pressure) favours the forward reaction (1) **allow** speeds up reaction (1) **allow** high level answers relating to collision theory e.g. more successful / frequent collisions (1) **allow** (high temperature) makes less ammonia (1) **allow** (high temperature) favours the back reaction (1) **allow** speeds up reaction (1) **allow** high level answers relating to collision theory e.g. more successful / frequent collisions (1) **allow** 450^oC is an optimum temperature giving a fast reaction with a sufficiently high percentage yield (2)
	Total	**6**	

Question	Answer	Marks	Guidance
8 a	**Level 3** **Selects a suitable material for both of the uses giving 2 relevant reasons for each material** **AND** **provides a reason for rejecting at least one of the other materials for both uses** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Selects a suitable material for one of the uses giving at least 2 relevant reasons** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Applies knowledge to evaluate at least one material to make a girder** **OR** **one material to make a kitchen worktop** **OR** **selects a suitable material for either use (no reasons given)** **OR** **applies knowledge to make a comparison between the properties of at least two materials** 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. (0marks)	6	**This question is targeted at grades up to A*.** **Level 3 cannot be accessed unless there are correct choices for both applications.** **Indicative scientific points may include:** **evaluation for girder** • A is too weak but is cheap • B is very strong and cheap but can corrode • C is weak and expensive • D is weak and expensive • E is strong and corrodes slowly but very expensive • F is very weak and expensive **choice for girder either** • material B • it is the strongest and is cheap **or** • material E • it is strong and does not corrode or corrodes slowly **evaluation for worktop** • A is absorbent but quite hard and cheap • B is hard, strong and relatively cheap but corrodes • C is hard, reasonably strong, unaffected by water but is quite expensive • D is hard, reasonably strong, unaffected by water but is quite expensive • E is soft but strong, corrodes slowly and is expensive • F is soft and weak, absorbs water and is expensive **choice for worktop either** • material D • as it is quite hard, cheaper (than C), does not absorb water, does not corrode and density lower than C **or** • material C • as it is hardest, does not absorb water, does not corrode and density higher than D **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

Question	Answer	Marks	Guidance
b	**one from** **disadvantages** increased noise (1) increased traffic (1) increased dust (1) destruction of landscape (1) destruction of habitats (1) loss of tourism (1) **and one from** **advantages** provides materials (required for construction) (1) provides jobs (1) companies required to reconstruct landscape (1) economic benefits for the local area (1) reduces need to import materials (1)	2	 **ignore** air pollution **ignore** damages the environment **allow** causes disruption to people living near it (1) **allow** pollution from trucks or machines working at the site (1) **allow** destroys land (1) **ignore** takes up land **allow** spoils the view (1) **allow** visual pollution (1) **allow** idea that it is expensive to restore land to its former condition (1) **allow** idea that **disused** quarries can be dangerous e.g. lakes (1) **allow** harms animals and/or plants (1) **allow** produces useful product (1) **allow** can get ores more easily than mining (1) **allow** improved infrastructure e.g. roads (1) **allow** idea that quarry can be redeveloped for recreational purposes e.g. rock climbing (1) **ignore** build more houses
		8	

Question	Answer	Marks	Guidance
9 a	**any two from** idea that aluminium has a low(er) density or lightweight (1) so will give better fuel economy (1) (aluminium) does not corrode (1) so (car body) will last longer (1)	2	**assume answer refers to aluminium unless otherwise stated** **ignore** aluminium is lighter **allow** aluminium does not rust (1) **allow** higher level answers referring to the protective oxide layer on aluminium (1) **allow** aluminium is (more) malleable (1) so easier to shape (1) **ignore** references to cost or strength or flexibility
b	**any three from** anode is impure copper (1) cathode is pure copper (1) electrolyte is copper sulfate solution (1) idea that cathode gains mass (as copper is deposited) or pure copper deposited on the cathode (1) idea that anode loses mass (as copper dissolves)or idea that anode dissolves (1)	3	**Read text first. If 3 marking points have not been used up from the text look at the diagram for possible extra marking points. If labels on the diagram contradict the text, text takes precedence.** marks can be awarded from a **labelled** diagram **allow** copper ions are reduced at the cathode (1) **allow** $Cu^{2+} + 2e^- \rightarrow Cu$ (1) **allow** copper atoms are oxidised at the anode (1) **allow** copper ions are produced at the anode (1) **allow** $Cu - 2e^- \rightarrow Cu^{2+}$ (1)
	Total	**5**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>10 a</td><td><table><tr><th>Fact</th><th>Opinion</th></tr><tr><td>✓</td><td></td></tr><tr><td>✓</td><td></td></tr><tr><td></td><td>✓</td></tr><tr><td></td><td>✓</td></tr></table>(2)</td><td>2</td><td>all correct (2)
two or three correct (1)
one correct (0)</td></tr>
<tr><td>b</td><td>low energy bulb lasts longer / ora(1)

low energy bulb uses fewer units / is cheaper to use / costs less to run / ora (1)

idea of the relationship between cost to buy and lifetime (1)</td><td>3</td><td>assume answer refers to low energy bulb unless otherwise stated

ignore uses less energy or uses less electricity

allow calculation of running cost for both lamps Filament = £18, Low Energy= £3 (1)
but allow calculation of total cost for both lamps Filament = £20, Low Energy = £8 (2)

e.g. if you buy 10 filament bulbs they still will not last as long as 1 low energy bulb (1)
or
even with the £5.00 cost of the low energy lamp the total cost is less than the electricity alone for the filament lamp (1)
or
it costs £5 for one lifetime of a low energy bulb, but in the same time it would cost £8.50 or £8.33 of filament bulbs (1)</td></tr>
<tr><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
11 a i	gamma (1) idea that **only** gamma can penetrate (dense) metal or iron or that gamma has the greatest penetrating power (1)	2	**2nd mark is dependent on identifying gamma** **allow** alpha **and** beta cannot penetrate iron (1) **allow** only gamma can pass through iron (1)
ii	**idea that** increased count rate or greater amount of radiation is detected if an air gap is present (1)	1	**ignore** reference to radiation type
b i	the atoms become charged (1) by loss (or gain) of electrons (1)	2	**allow** molecules lose or gain electrons to become charged (2) **allow** electrons are lost to give **positive** ions (2) **allow** electrons are gained to give **negative** ions (2) **ignore** reference to oxidation is loss of electrons / reduction is gain of electrons
ii	damages DNA (1)	1	**allow** changes the DNA (1) **allow** causes cancer (1) **allow** causes mutation (1) **allow** causes infertility (1) **ignore** kills cells
	Total	**6**	

Question	Answer	Marks	Guidance
12	**[Level 3]** **Identifies inverse square relationship between distance and current** **AND** **Suggests a reason why current decreases as distance increases to include reference to electrons knocked loose** Quality of written communication does not impede communication of the science at this level (5 – 6 marks) **[Level 2]** **Identifies the trend to include non-linear nature** **AND** **suggests a reason why current decreases as distance increases.** Quality of written communication partly impedes communication of the science at this level (3 – 4 marks) **[Level 1]** **Identifies a simple trend** **OR** **suggests a reason why current decreases as distance increases.** 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 at level 3 may include:** there is an inverse square law between distance and current / specific relationship using data e.g. from 20 to 40 doubles the distance but quarters the current (less) light / energy falling on panel so (fewer) electrons knocked loose from the silicon fewer electrons moving therefore less current **Indicative scientific points at level 2 may include:** as distance increases the current decreases non linearly / at a different rate / AW less light / energy from the light source as distance increases **Indicative scientific points at level 1 may include:** as distance increases the current decreases / AW less light / energy from the light source as distance increases **allow** milliamps for current **Use the L1, L2, L3 annotations in scoris.** **Do not use ticks.**
	Total	**6**	

Question	Answer	Marks	Guidance
13 a	11 (kV) (1)	1	
b	3.06×10^8 / 306 000 000 (J) (2) **but if incorrect** $0.34 \times 9 \times 10^8$ or $34\% \times 9 \times 10^8$ (1)	2	**allow** 306 MJ or 306 000 kJ (2)
	Total	**3**	

Question	Answer	Marks	Guidance
14 a	(interstellar gas cloud) proto star main sequence star red giant (white dwarf)	2	all correct (2) one or two correct (1) **if no other marks awarded,** if all three stages have been correctly selected but in the wrong order answer scores (1)
b	no light can escape (a black hole) (1) because it has a (very) strong gravitational attraction or (very) strong force of gravity or strong gravitational field (1) **or** (very) strong gravitational attraction or (very) strong force of gravity or strong gravitational field (1) because it has a (very) large mass (1) **or** high density (1) because it has large mass and small volume or gives rise to a (very) strong gravitational attraction or (very) strong force of gravity or strong gravitational field (1)	2	**allow (**black hole) traps light (1) **allow** strong gravitational pull (1) **allow** strong gravitational pull (1) **allow** strong gravitational pull (1)
c	(Distant galaxies) move away **faster** ORA (1)	1	**allow** recede **faster** (1)
	Total	**5**	

Question	Answer	Marks	Guidance
15 a		4	**It is not possible to document all possible responses. If a response is not covered by the mark scheme then examiners need to check the data to see if the response is correct. If it is correct award the mark.**
	up to two from idea that total consumption is generally upward (with minor drops) (1) drops occur in 2001 or 2005 or 2008 or 2009 (1)		**allow** highest amount used was in 2010 (1) **allow** idea that in 2000 the amount of copper used in different parts of the world are roughly the same **apart from Africa** (1)
	then up to three from Europe – small rise from 2000 to 2007 or 2008 then drops (1) Africa – slight (absolute) increase or very little (absolute) change (1) – amount of copper used doubles (1) Africa - uses least copper (1) Asia – (consistent) increase (1) Asia – uses most copper (1) America – slight drop 2000 to 2001 (1) - stays the same until 2008 (1) - drops in 2009 (1) - drops over the 10 year period (1)		**allow** Europe quite constant except in 2009 (1) **allow** Europe has used less between 2008 to 2010 (1) **allow** broadly steady with one or two drops (1)
	Comparisons (**up to a maximum of 2**) – e.g. Asia uses more copper than America (1)		

Question	Answer	Marks	Guidance
b i	China (1) idea of (greatest) difference is between 3780 and 5430 / (greatest) difference is 1650(1) **then any one from** increased industry (1) growing economy (1) large or growing population (1) developing country (1) making more goods needing copper (1)	3	**if China not identified then only 3rd mark is available** **Check alongside table for calculation of differences** **allow** use of percentage increase instead **allow** working out to calculate differences **allow** industry uses more copper (1) **allow** more building or construction (1) **allow** world population has increased (1) **ignore** more people use it **allow** increase in computer industry (1)
ii	**any one from** China is using more copper than it is making (1) China will need to import copper (1)	1	**allow** higher percentage used than (percentage) produced / ora (1) **allow** China does not have enough copper for its needs (1) **allow** China will run out of copper (1) **allow** China will need to buy copper (1) **allow** China would have to recycle more copper (1) **ignore** just 'not enough copper'
iii	**any one from** (in 2012) more copper needed than produced (1) a shortage of copper (in 2012)(1) in 2008 more copper produced than needed (1) a surplus of copper in 2008 (1) **then any one from** price of copper likely to increase (1) more use of recycling needed (1) need to find more copper reserves (1)	2	**no marks for completing the table** **if no date is specified, assume answer refers to 2012** **allow** (in 2012) there is more demand than supply (1) **allow** in 2008 there is more supply than demand (1) **allow** idea of detrimental effect on industry (1) **allow** need to find alternatives to copper (1) **ignore** copper will run out
	Total	**10**	

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