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 2017

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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 used in scoris

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 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	no (no credit) idea that there is no continuously increasingly rapid growth phase (1)	1	If yes then question scores 0 **allow** it rises but then falls (in a short amount of time) (1) **allow** it has some decreases in it (1) **allow** the number fluctuates (1) **allow** it only increases by a small amount in 25 years (1) **allow** it only increases gradually (1)
b	**any two from:** idea of limited food or water or prey available / disruption to the food chain / more competition for food (1) idea of lack of or more competition for space or habitat (1) idea of increased risk of disease (1) idea of shortage of (a named) resources / increased intraspecific competition (1)	2	**allow** more food needed (1) **allow** lack of food resources (1) **allow** not enough land for them to feed on (2) **allow** habitat overcrowded (1) **ignore** just more competition **ignore** competition for mates e.g. fertilisers (1) **ignore** species could become extinct or endangered **allow** consequences specific to humans e.g. lack of sanitation / health provision / transportation needs / increased demand for energy / increased unemployment / more carbon dioxide produced / build up of waste (1)
c	reproductive (isolation)(1) if rare hybrid is formed then hybrids can't produce viable offspring or fertile offspring (1)	2	**allow** reproduction isolation (1) **allow** hybrids are sterile (1) **allow** hybrids are infertile or cannot reproduce (1)
	Total	5	

Question	Answer	Marks	Guidance
2 a	(Ben) (no credit) idea that trees are renewable / (can be replanted) so can be sustainably developed / forests are replaced so environment not harmed (1) idea that coal is non-renewable or finite / coal cannot be sustainably developed (1)	2	**If Hollie then 0 for question** **allow** trees are sustainable (1) **allow** burning trees is carbon neutral (1) **ignore** trees are replanted **allow** coal is not sustainable (1) **allow** coal takes thousands or millions of years to form (1) **allow** coal can't be replaced (1) **allow** burning coal produces sulfur dioxide (1) **allow** coal will run out (1) **ignore** coal is limited **ignore** coal is a fossil fuel **ignore** comments about pollution, acid rain and global warming
b	help: reduces acid rain (1) **and any one from:** harm: because microbes might cause disease (1) unsure how microbes will behave in environment / disturb food webs (1)	2	answers must be in correct category **allow** stops acid rain (1) **ignore** reduces pollution **allow** idea that microbes can't be controlled once in the environment (1) **ignore** microbes harm the environment
c i	50 (%) (1)	1	
c ii	**any two from:** idea that **at the start** (of the 5 year period) actual numbers of tuna caught are increasing (1)	2	

	catch size is (always) higher than the quota / ora (1) idea that (reducing the quota) brings the catch size down **at the end** or when the quota is small (1)		**allow** demand or estimate is (always) higher than the quota / ora (1) **allow** catch size has started to come down (1) **ignore** from 2005 to 2009 the catch decreases
	Total	**7**	

Question	Answer	Marks	Guidance
3 a i	genus	1	**allow** correct answer circled, underlined or ticked but answer line takes precedence
a ii	idea that it identifies the species in a common language / idea that otherwise tree will be called different things in different countries / idea that can be identified by scientists all over the world (1)	1	**allow** universally understood or recognised name (1)
b i	**competition** ☐ **genes** ☑ **habitats** ☐ **populations** ☐	1	**more than one tick is zero**
b ii	the role or position of an organism within the environment / how an organism fits into its habitat (1) Then **any one from:** they will have similar needs such as minerals / light / water / food (1) they will have similar adaptations (to their environment) (1) eaten by the same organisms (1)	2	**allow** ecological habitat they live and breed in (1) **allow** how it meets its needs for food / shelter (in the environment) (1) **allow** need similar resources (1)

c i	**any two from:** (small, isolated populations mean) more inbreeding (1) (inbreeding) reduces **genetic** variation (1) increased prevalence of harmful recessive alleles or genes (1) (lack of variation leads to) reduced ability of species to respond to environmental change (1)	**2**	**ignore** idea of difficult to find a mate **allow** reduced gene pool (1) **allow** increases the chance of genetic abnormalities or diseases or faults being seen (1) e.g. reduces ability to fight a particular disease (1) **ignore** mutations **ignore** references to poaching or hunting

Question	Answer	Marks	Guidance
c ii	**[Level 3]** **Describes the way koalas compete well in habitats with gum trees** **AND** **suggests a reason why koalas compete worse after bushfires** **AND** **suggests a reason why mice compete better after bushfires** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **Describes the way koalas compete well in habitats with gum trees AND suggest a reason why koalas compete worse after bushfires** **OR**	**6**	**This question is targeted at grades up to A*.** **Indicative scientific points at level 2 and 3 may include:** • koalas compete well due to feeding on gum trees that other animals cannot eat • koalas have lost their food source and/or habitat and cannot compete in different types of habitat • specialist only suited to gum tree habitat which takes time to recover • mice still have underground food source / habitat • generalists compete in a range of different habitats / for different food sources so will be able to compete for other food sources / habitats

	Describes the way koala competes well in habitats with gum trees AND suggests a reason why mice compete better after bushfires. **OR** **Suggests a reason why koalas compete worse after bushfires AND suggests a reason why mice compete better after bushfires.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** **Describes the way koala competes well in habitats with gum trees.** **OR** **makes a valid comment that attempts to show the difference between koala and mice** **OR** **Suggests why koalas compete worse after bushfires** **OR** **Suggests why mice compete better after bushfires** 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.		**Indicative points at level 1 include:** • koalas compete well due to feeding on gum tree leaves that other animals cannot eat • mice have a more varied food supply / koala only eat one type of food • koalas have lost their food source • mice cannot eat gum tree leaves **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	**13**	

Question	Answer	Marks	Guidance
4 a	H_2SO_4 (1)	1	**allow** SO_4H_2 / O_4SH_2 / SH_2O_4 / H_2O_4S / O_4H_2S / $S(O_2H)_2$ (1)
b	(by two atoms) sharing (a pair of) electrons (1)	1	**not** two molecules sharing (a pair of) electrons
c i	sodium sulfate / sodium hydrogensulfate (1) water (1)	2	**allow** Na_2SO_4 / $NaHSO_4$ (1) **allow** H_2O (1)
ii	$H^+ + OH^- \rightarrow H_2O$ (2) reactants correct (1) product correct (1)	2	**allow** OH_2 for water (1) **allow** ⇌ instead of → **allow** any correct multiples
	Total	6	

Question	Answer	Marks	Guidance
5 a	yes (no mark) it is soluble (1) contains all (three**)** of the **essential** elements (nitrogen, phosphorus and potassium) (1)	2	**If no then 0 for question** **allow** better than **E** as **E** is insoluble (1) **not** it is soluble so washes through the soil (and causes eutrophication) if oxygen is included as an essential element, this mark is lost **allow** nitrate for nitrogen and phosphate for phosphorus **allow** contains NPK (1)
b	ammonia used to make fertilisers / ammonia is a fertiliser (1) (fertilisers) increase **crop** yield (1)	2	**allow** idea that ammonia provides nitrogen or nitrates to the soil / nitrogen is needed to make plant protein (1) **allow** fertilisers contain ammonia (1) **ignore** crops grow better / makes plants grow **allow** to grow more **crops** (1) **allow** to grow bigger **crops** (1) **allow** to grow **crops** faster (1)
	Total	4	

Question	Answer	Marks	Guidance
6	**Level 3** **Detailed description of the theory of plate tectonics including <u>how</u> the plates move** **AND** **explains in detail why the theory is now accepted** Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **Level 2** **Detailed description of the theory of plate tectonics including <u>that</u> the plates move** **OR** **gives a limited description of the theory of plate tectonics and attempts to explain why the theory is now accepted** **OR** **explains in detail why the theory is now accepted** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Gives a limited description of the theory of plate tectonics** **OR** **attempts to explain why the theory is now accepted** 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*.** **Indicative scientific points may include:** **Theory of plate tectonics** • tectonic plates move because of movement of semi-rigid magma / **convection currents** (in the mantle) (this is required for access to level 3) • lithosphere or crust or Earth's surface is made of tectonic plates that move slowly • tectonic plates fit together (like a jigsaw) • tectonic plates less dense than magma so float on it • two types of tectonic plates – oceanic and continental • oceanic plate more dense than continental plate / ora • description of subduction or mountain building • movement of tectonic plates causes earthquakes and volcanic eruptions **Explanation** • lots of evidence fits in with the theory e.g. continental drift, similar fossils found on different continents • new research carried out which has given new evidence which agrees with the theory • examples of new evidence e.g. sea floor spreading, use of GPS to track plate movement • can only use seismic waves to investigate inner layers Marks can be awarded from a **labelled** diagram **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	**6**	

Question	Answer	Marks	Guidance
7 a	do experiment with dry air (1)	1	**allow** just in oxygen (1) **allow** no moisture (1) but no moisture or acidity scores 0 **allow** description of sealed tube with a desiccant (to remove water) (1)
b	it is a reaction with oxygen / oxygen is added / an oxide is made (1)	1	**allow** because **iron** loses electrons (1) **allow** it has turned to iron oxide (1) **allow** O_2 gains electrons to form an oxide (1) **allow** uses oxygen (1) **allow** oxygen is a reactant (1) **allow** reacts with oxygen and water (1) **ignore** uses water
c	$4Al + 3O_2 \rightarrow 2Al_2O_3$ correct formulae (1) balancing (1)	2	balancing mark is conditional on correct formulae **allow** = or ⇌ instead of arrow **not** and or & instead of + **allow** any correct multiples including fractions $8Al + 6O_2 \rightarrow 4Al_2O_3$ (2) **allow** one mark for correct equation with minor errors in case, subscript or superscript e.g. 4AL + 3O2 → 2AL2O3
	Total	4	

Question	Answer	Marks	Guidance
8 a	calculate the mean or average values (1) draw a line graph (1)	2	 **allow** draw a scatter graph (1) **ignore** draw a graph / draw a bar chart
b	(reinforced beam) has the hardness of concrete / (reinforced beam) is hard (1) (reinforced beam) has the flexibility of steel / (reinforced concrete) is more flexible (than non-reinforced concrete) (1) (reinforced beam) has the strength of steel / (reinforced concrete) is stronger (than non-reinforced concrete) (1)	3	assume that the answer refers to reinforced concrete **allow ora** if non-reinforced concrete is specified **allow** reinforced concrete is flexible (1) **allow** correct description e.g. steel prevents the concrete from cracking (1) **not** reinforced concrete is more malleable than non-reinforced concrete **allow** reinforced concrete is strong (1) **allow** steel prevents the concrete from breaking (1) **allow** reinforced concrete beams can carry more weight (1) **allow** idea that concrete is weak in tension but steel rods make it strong(er) in tension (1)
	Total	5	

Question	Answer	Marks	Guidance
9 a		3	**Use ticks on this question** **ignore** references to more or less electricity **allow** output or it for current **ignore** power
	idea that doubling speed increases current or output / ora (1)		**allow** any idea that as speed increases the current increases / ora (1)
	idea that halving strength (of the magnet) reduces current or output / ora (1)		**allow** any idea that as strength (of magnet) decreases the current decreases / ora (1)
	idea of one effect compensates the other / current stays the same / current is (still) 0.5A (1)		e.g**.** one doubles current but other halves it (1) **allow** he should have left the strength of the magnet the same (1)
b i	41.6% recurring or 41.67% or 41.7% or 42% or 0.417 or 0.4167 or 0.42 so meets or exceeds target (2) **but** 41.6% recurring or 41.67% or 41.7% or 42% or 0.417 or 0.4167 or 0.42 with no statement about meeting the target (1) **if incorrect or incomplete then:** $\frac{5}{12}$ x 100(%) (1)	2	correct value **and** judgement needed for both marks **allow** 41.6% or 41.66 or 0.416 or 0.4166 so meets the efficiency target (1)

	or 58.3% or 58% (wasted) so meets / exceeds target (1) **Alternatively** 40% of 12 = 4.8 so 5 is greater than 4.8 so power station meets the efficiency target (2)		
ii	**any two from:** **water** is heated / boiled / turned into steam (1) **steam** turning turbine / **steam** spins or turns or drives the turbine (1) turbine spins or turns or drives the generator (1)	**2**	 **ignore** fuel burned or heated **ignore** just steam enters the turbine **allow** turbine spins dynamo (1) **ignore** electricity generated
iii	voltage increases (1) current reduces (1) temperature reduces **/** less energy wasted / AW (1)	**3**	**use ticks on this question** **allow** wires heat up less (1) **not** no energy loss
	Total	**10**	

Question	Answer	Marks	Guidance
10 a	**any two from**:	2	
	easier and quicker (1)		e.g. more work could be done at once / more evidence can be found / speeds up investigations / more cost effective / quicker results (1)
	geographical reasons (1)		e.g. may be several sites need inspecting / different countries have different types of nuclear power stations / in a nuclear emergency teams from other countries could help (1)
	sharing ideas, knowledge and expertise (1)		e.g. so they can rely on each other's strengths / some countries have more use or experience of nuclear power so have more experience or data from research / if one scientist dies, his work can be carried on / different specialisms available / many different perspectives can be used to develop an investigation (1)
	less chance of bias / findings more trustworthy (1)		e.g. more believable outcomes / because one scientist could fake the results otherwise / evidence is more easily checked / (1)
	benefit the whole of humanity/mankind (1)		e.g. share the cost (1)
b	**[Level 3]** **Reference to two correct ways of disposing of nuclear waste** **AND**	6	**This question is targeted up to grade A*** **Indicative scientific points may include:** **Level 3:** **Both:** • low level – in land fill or buried • **AND** high level – encased in glass and buried (very deeply) underground or reprocessed or stored under water

	two problems of dealing with radioactive waste <u>explained in detail</u>. Quality of written communication does not impede communication of the science at this level. **(5 – 6 marks)** **[Level 2]** **Reference to two correct ways of disposing of nuclear waste** **AND** **one problem of dealing with radioactive waste mentioned** Quality of written communication partly impedes communication of the science at this level. **(3 – 4 marks)** **[Level 1]** **Reference to one correct way of disposing of nuclear waste.** **OR** **one problem of dealing with radioactive waste mentioned** Quality of written communication impedes communication of the science at this level. **(1 – 2 marks)** **Level 0: (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.		• **allow** idea that high level waste is encased in lead or concrete or steel and buried (deep) underground **AND two from:** • radioactive for a long time **explained** – e.g.so levels stay (too) high / above safe limits / long half life / causes ionisation • terrorist risk from plutonium **explained** – e.g. use for (dirty) bombs • groundwater risk **explained** - where contamination may get into drinking water / ecosystem / food chain • acceptable levels may change over time **Level 2:** **Both:** • low level – in land fill or buried • high level – encased in glass **and** buried (very deeply) underground or reprocessed or stored under water • **allow** idea that high level waste is encased in lead or concrete or steel and buried (deep) underground **AND one from** • radioactive for a long time • terrorist risk • groundwater risk **Level 1:** • low level – in land fill or buried • high level – encased in glass **and** buried (very deeply) underground or reprocessed or stored under water • **allow** idea that high level waste is encased in lead or concrete or steel and buried (deep) underground • radioactive (for a long time) • terrorist risk • groundwater risk **ignore** references to alpha, beta and gamma radiation **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	**8**	

Question	Answer	Marks	Guidance
11 a	highest speed in1986 or 1910 **and** lowest speed in 1952 (1)	1	dates required for both highest and lowest speed if one correct and one incorrect for highest speed scores 0. **allow** any year in the range 1948 ➔ 1956
b	(idea that) gravitational/centripetal force (is needed for circular motion) (1) stronger force when near to Sun / ora (1) acceleration / speed / kinetic energy of comet greatest near Sun / ora (1)	3	**use ticks in this question** If Earth rather than Sun then max 2 i.e. first answer referring to Earth rather than Sun loses the mark – after that two further marks can be awarded. **allow** acceleration / speed / kinetic energy of comet greatest when gravity is strongest (2)
	Total	4	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>12 a</td><td>current in kettle calculated as 10A and 13A fuse and 15A cable chosen (3)

if answer is incorrect or incomplete

current in kettle calculated as 10A and wrong fuse or cable chosen scores (2)

or

current = $\frac{2300}{230}$ (1)
or

power of kettle calculated as 2300W or 2.3KW (1)

or

power = $\frac{276\,000}{120}$ (1)</td><td>3</td><td>allow correct choice of cable and fuse for calculated current (1)
e.g. current =1.2A so use 3A fuse and 5A cable (1)

<table><tr><th>Range of current</th><th>Recommended fuse</th><th>Recommended cable</th></tr><tr><td>0 to 2.9A</td><td>3A plug fuse</td><td>5A</td></tr><tr><td>3 to 4.9A</td><td>5A plug fuse</td><td>7A</td></tr><tr><td>5 to 9.9A</td><td>13A plug fuse</td><td>13A</td></tr><tr><td>10 to 12.9A</td><td>13A plug fuse</td><td>15A</td></tr></table></td></tr>
</table>

				13A to 19.9A	20A circuit fuse	30A static cable	
				20 to 49.9A	50A circuit fuse	60A static cable	
	Total	**3**					

Question	Answer	Marks	Guidance
13 a i	470 ± 20 (thousand tonnes) (1)	1	
ii	**any two from:** less electricity generation (1) idea that more renewable fuels or renewable sources or nuclear fuels used to generate electricity / less fossil fuels burned (1) less energy used for heating / idea of better home insulation (1) reduced manufacturing industry (1) idea of more efficient car engines (1) more electric or hybrid cars (1) better control of emissions (1)	2	**allow** more efficient electricity generation (1) **allow** people are using less electricity / more energy saving technology (1) **allow** less coal or gas or oil is used (1) **allow** named renewable used (1) **ignore** fuel used to make sulfur dioxide could have run out **allow** less factories (1) **allow** removal of sulfur from petrol (1) **allow** idea of more use of catalytic converters (1) **ignore** fewer cars on the road e.g. (climate change) legislation / filters or scrubbers in factories to reduce sulfur dioxide emissions (1) **ignore** cleaner car engines **ignore** people have become more eco-friendly
b i	**any three from:** overall amount of NO_x decreasing (1) main contributor to NO_x is road transport (1) less made by road transport (between 1990 and	3	**use ticks on this question** **allow** difference between 1990 and 2010 is 600 (thousand tonnes) (1)

<table>
<tr><td></td><td>2010) (1)

manufacturing industry stays broadly the same (1)

household heating is broadly the same (1)

household heating is the least (between 1990 and 2010) (1)

idea that electricity generation shows no pattern (1)</td><td></td><td>allow manufacturing industry falls by a small amount or by 10 (thousand tonnes) (1)

allow idea that electricity generation fluctuates or a description of how it fluctuates (1)</td></tr>
<tr><td>ii</td><td>manufacturing industry = 21.8% ± 0.2% (1)

generating electricity = 10.9% ± 0.2% (1)</td><td>2</td><td></td></tr>
<tr><td>c</td><td>any two from:
lower (percentage of) NOx made by generating electricity in France / greater (percentage of) NOx made by generating electricity in the UK (1)

greater (percentage of) NOx made by household heating in UK / lower (percentage of) NOx made by household heating in France (1)

lower (percentage of) NOx made by road transport in the UK / greater (percentage of) NOx made by road transport in France (1)

road transport accounts for most oxides of nitrogen pollution in both countries (1)

similar percentages made by manufacturing industry (1)

household heating creates least NO_x in both countries (1)</td><td>2</td><td>allow ecf from incorrect percentages calculated in part (b)(ii)
allow correct percentages quoted even if rounded to the nearest whole number
<table><tr><td></td><td colspan="2">% oxides of nitrogen produced</td></tr><tr><td></td><td>UK</td><td>France</td></tr><tr><td>Road transport</td><td>40</td><td>58.2</td></tr><tr><td>Generating electricity</td><td>20</td><td>10.9</td></tr><tr><td>Manufacturing</td><td>22</td><td>21.8</td></tr><tr><td>Household heat</td><td>16</td><td>9.1</td></tr></table></td></tr>
<tr><td></td><td>Total</td><td>10</td><td></td></tr>
</table>

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