OCR
RECOGNISING ACHIEVEMENT

GCSE

Science B

General Certificate of Secondary Education

Unit **B712/02:** Unit 2: Modules B2, C2, P2 (Higher Tier)

Mark Scheme for January 2013

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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.

For answers marked by levels of response:

a. **Read through the whole answer from start to finish**
b. **Decide the level** that **best fits** the answer - match the quality of the answer to the closest level descriptor
c. **To determine the mark within the level,** consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

d. Use the L1, L2, L3 annotations in Scoris to show your decision; do not use ticks.

Quality of Written Communication skills assessed in 6 mark extended writing questions include:

a. appropriate use of correct scientific terms
b. spelling, punctuation and grammar
c. developing a structured, persuasive argument
d. selecting and using evidence to support an argument
e. considering different sides of a debate in a balanced way
f. logical sequencing.

Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt **not** given
	error carried forward
	information omitted
	ignore
	reject
	contradiction
	Level 1
	Level 2
	Level 3

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)	**any two from:** decay / decomposition / decomposing (1) respiration (1) from microbes / bacteria / fungi / animals / plants (1)	2	 **allow** decomposers **allow** (by) humans **allow** animals (breathe it out) / humans (breathe it out) / we (breathe it out) **allow** living things / organisms / named organism **allow** volcanoes **allow** weathering **ignore** combustion / burning **but allow** combustion / burning of wood **ignore** when trees are cut down **ignore** breathing
		(ii)	photosynthesis / plants change carbon dioxide into oxygen / plants take in carbon dioxide and change it into glucose (1)	1	**allow** absorbed by water / dissolved by water / reacts with water **allow** makes carbonic acid / makes carbonate / makes limestone **ignore** carbon cycle

Question			Answer	Marks	Guidance
	(b)	(i)	acid rain (1) **plus one effect of acid rain – this mark is independent of the first marking point** weathering (of stone, buildings or statues) / erosion (of stone, buildings or statues) / increased rate of rusting / corrosion of metals / damage to crops / death of plants / death of fish / acidification of lakes / acidification of soil / damage to leaves (1)	2	**allow** forms sulfuric acid / forms sulfurous acid **ignore** global warming **not** destroying ozone layer **allow** damages buildings / wears away limestone **ignore** harms buildings / harms wildlife / damages living things **ignore** pollutes water
		(ii)	lichen(s) (1)	1	**allow** indicator species **allow** description of an indicator species e.g. look for a species that only grows when sulfur dioxide is in low or high concentrations **allow** spectroscopy **allow** test acidity of the rain / test pH of the rain water **ignore** acidity of the atmosphere
			Total	**6**	

Question			Answer	Marks	Guidance
2	(a)		**A** 9.4 / 9 (%) **B** 20 (%) **C** 18.8 / 19 (%) all three correct (2) **but** one or two correct (1)	2	**allow** 9.41 (%) **allow** 18.75 (%) **allow** one mark for 0.09, 0.2 **and** 0.19 (but all three must be there) if no other mark has been awarded
	(b)		**A, B or C** **any two from:** energy lost through egestion (1) because food less easily digested (1) energy lost through respiration (1) because it is active / because it moves (1) energy lost through excretion (1) heat loss (1)	2	no mark for **the letter** on its own i.e**. ignore** the letter just look at the reasons no marks if reasons related explicitly to plants **allow** fewer parts can be digested **ignore** not all of it is eaten
	(c)		idea that not enough energy (to support another species) / idea not enough energy (to support the population) (1)	1	**allow** not enough energy left (to pass onto another animal) **not** no energy left / energy has run out
			Total	**5**	

Question			Answer	Marks	Guidance
3	(a)		**Level 3 (5–6 marks)** Natural selection of penguins described to include ideas about variation, competition, selection and inheritance **AND** an appreciation that over a long period of time enough differences may accumulate to constitute a new species. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Natural selection of penguins described to include at least three ideas from variation, competition, selection or inheritance. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Some stages of natural selection are described. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A.** **Relevant scientific points at level 3 must include:** • idea that eventually the penguins became so different from their ancestors that they became a new species. **Relevant scientific points could include:** stages of natural selection: • idea of variation among penguins • some penguins were more streamlined than others / some penguins are better swimmers • idea of competition • more streamlined penguins were better able to catch more food / more streamlined penguins could escape predators • more streamlined penguins were more likely to survive / idea of survival of the fittest / idea of selection • streamlining is controlled by genes • the genes for streamlining are passed on from one generation to another / the genes for streamlining are inherited descriptions of natural selection at levels 2 and 3 must refer explicitly to streamlining or swimming in penguins **ignore** generic descriptions at levels 2 and 3 but allow at level 1 Use the L1, L2, L3 annotations in scoris. Do not use ticks.
	(b)		Waimanu (1)	1	
	(c)		lack of predators / lack of competitors (1) many niches available (1)	2	**allow** no dinosaurs left to eat them **allow** more food available **allow** greater range of safe habitats

Question			Answer	Marks	Guidance
	(d)	**(i)**	live in same environment / live in similar environments / both live in water (1) (so) have same adaptations / similar adaptations / feed in same way / feed in similar way (1)	2	**allow** convergent evolution **allow** both swim **allow** both adapted to swim / streamlined to swim (2) streamlined on its own is **not** sufficient have similar features is **not** sufficient **but allow** have similar features **to survive** **allow** similar beak to catch fish **ignore** eat the same things / have a beak / have wings
		(ii)	reference to DNA (sequences) / genes (1) **BUT** idea that DNA (sequences) not as similar as would be if more closely related / idea that genes would be more similar if closely related (2)	2	**allow** look at the genetics **ignore** chromosomes **allow** (the longer the time since a common ancestor the) greater difference in their DNA (sequences) (2) **allow** less DNA hybridisation (2) **allow** other valid answers: differences in immunology / (antipenguin / antigrebe) antibodies react or cause a precipitate with the other bird's blood difference in biochemistry / difference protein sequences **BUT** **allow** large reaction or precipitation when antibodies tested with the other bird's blood (2) **allow** large difference in their biochemistry / large difference in the amino acid sequence in proteins (2)
	(e)		heat is transferred from warm blood (leaving the main body to go to the feet) to cool blood (returning to the main body from the feet) (1)	1	**allow** the warm blood warms up the cold blood (returning from the feet to the body) **ignore** cold blood replaced by warm blood
			Total	**14**	

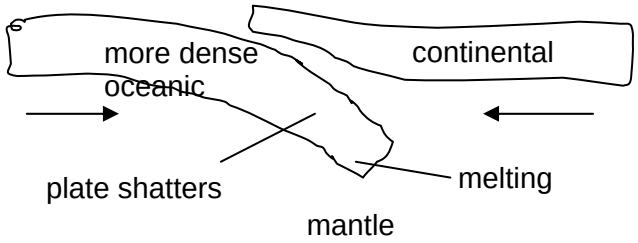
Question			Answer	Marks	Guidance
4	(a)		20 (1)	1	
	(b)		calcium carbonate / $CaCO_3$ (1)	1	
	(c)		so it can be absorbed by the plant / so it can be absorbed by the roots (1)	1	**allow** so it can be easily sprayed onto the land **allow** so plants can take it in / so plants can take it up **ignore** so it can reach the roots **ignore** absorbed by soil
	(d)	(i)	sulfuric (acid) / H_2SO_4 (1)	1	**allow** hydrogen sulfate
		(ii)	titration / description of titration (1) alkali added to acid until it is just neutralised or vice versa (1)	2	**allow** slow or dropwise addition of an acid (to an alkali) or vice versa / aw **allow** use a burette to add acid (to alkali) or vice versa **allow** until indicator or named indicator just changes colour / use of pH meter to tell when until pH = 7 / add till it is just neutral **allow** marks from a labelled diagram  **allow** ecf names of acid from (d)(i) concentrate on the experimental method

Question			Answer	Marks	Guidance
4	(e)		idea of using less fertiliser reduces eutrophication / idea of using less fertiliser reduces death of aquatic life (1) using more fertiliser increases crop yield **AND** will benefit larger numbers of people / AW (1)	2	**allow** more organic crops can be grown if synthetic fertilisers are not used faster growth or better growth is **not sufficient** answer must imply **more crops** or **greater yield** **allow** using more fertiliser allows the use of soil of low fertility to be used for crop production which benefits more people **allow** one mark for more fertiliser increases crop yield / more fertiliser allows use of soil with low fertility if no other marks have been awarded
			Total	**8**	

Question			Answer	Marks	Guidance
5	(a)		catalyst has no effect (1) (percentage) yield increases as temperature increases / ORA / AW (1) (percentage) yield decreases as pressure increases / ORA / AW (1)	3	**USE TICKS AND CROSSES IN THIS QUESTION** **allow** as temperature gets hotter % goes up / AW / ORA **ignore** changing the temperature increases the yield **allow** as pressure goes up % goes down / AW / ORA **ignore** changing the pressure deceases the yield
	(b)		**any two from:** use a catalyst to make reaction faster (1) recycle unreacted material so raw materials are not wasted (1) automate the system to reduce wages cost (1) have a continuous (rather than batch) process which will reduce down-time / continuous because it is easier to automate (1) reduce heat loss by using (better) insulation (1)	2	 **allow** recycle waste reactants / recycle unreacted reactants **not** recycle the waste products **ignore** automate so do not have to pay wages use less people to reduce the wage cost is **not** sufficient
			Total	**5**	

Question			Answer	Marks	Guidance
6			**Level 3 (5–6 marks)** Applies knowledge and understanding to evaluate an advantage and disadvantage for aluminium **AND** an advantage and disadvantage for steel AND make a comment about whether the metal is suitable to make a railway carriage. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Applies knowledge and understanding to give an advantage and disadvantage for aluminium **AND** an advantage and disadvantage for steel. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Applies knowledge and understanding to give an advantage and disadvantage for aluminium **OR** an advantage and disadvantage for steel. **OR** an advantage for each metal. **OR** a disadvantage for each metal. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science such as repeating the question. Answer not worthy of credit	6	**This question is targeted at grades up to A / A*.** **Relevant scientific points at level 3 must include:** • an evaluation of which metal would be most suitable – this could be aluminium , steel, or even both if clearly stated **Relevant scientific points include:** **Comments for aluminium:** • low density so better fuel economy • does not corrode so will last longer • malleable so can be made into correct shape • not very strong so might get damaged in a crash • not very hard so can get scratched easily **Comments for steel:** • strong so less damage in a crash • malleable so can be made into correct shape • corrodes slowly so will not last a long time or have to spend money on rust protection • hard so will not scratch easily • high density so poor fuel economy **ignore** references to cost / electrical conductivity / thermal conductivity / magnetic properties Use the L1, L2, L3 annotations in scoris. Do not use ticks.
			Total	**6**	

Question			Answer	Marks	Guidance
7	(a)		$2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + Cl_2$ (1)	1	**allow** any correct multiple including fractions **allow** = instead of → **allow** balanced equation on the line or on the original equation. If there is a **contradiction** take the answer on the answer line. **not** & or and instead of + **ignore** poor use of case or subscript
	(b)		cathode reaction is reduction because electrons are gained / hydrogen ions gain electrons which is reduction / hydrogen ions gain e^- which is reduction (1) anode reaction is oxidation because electrons are lost / chloride ions lose electrons which is oxidation / chloride ions lose e^- which is oxidation (1)	2	**ignore** oxidation is loss of electrons and reduction is gain of electrons **unless** linked to the correct reaction or electrode **not** cathode gains electrons **not** anode loses electrons
			Total	**3**	

Question			Answer	Marks	Guidance
8	(a)		idea that theory not accepted until new evidence was discovered (1)	1	**allow** not accepted until sea floor spreading discovered / not accepted until submarines could investigate constructive plate margins under the ocean **allow** it was just a theory, there was no evidence 50 years ago / there was no proof 50 years ago **allow** the technology to observe plate movements was not available 50 years ago
	(b)		oceanic plate moves under the continental plate because it is more dense / ORA (1) plate (moves into mantle where it) melts (1)	2	**allow** the oceanic plate subducts because it is more dense subduction on its own is **not sufficient** **allow** the plate shatters or cracks / AW **allow** all marks from a labelled diagram 
			Total	**3**	

Question			Answer	Marks	Guidance
9	(a)		coil or wire rotates / coil or wire turns (1) in a magnetic field (1) **OR** magnet rotates / magnet turns (1) in a coil or wire (1)	2	**allow** relative motion between coil or wire and magnetic field (2) **ignore** references to steam
	(b)		0.28 (2) **but if incorrect** $\frac{2.8 \times 10^5}{10^6}$ (1)	2	**allow** full marks for correct answer with no working out **allow** 28% (2) **but if incorrect** $\frac{2.8 \times 10^5}{10^6}$ × 100 (1) 28 on its own is **one mark only** 0.28% is **one mark only**
	(c)		idea that energy use to heat homes would normally have gone to waste (1)	1	**allow** heat / energy in the steam is used to heat homes **allow** the **useful** energy output is increased **allow** the **wasted** energy is being used **ignore** just the waste is recycled or used, must be clear it is the waste **energy** being reduced or used **not** the steam is not wasted
			Total	**5**	

Question			Answer	Marks	Guidance
10	(a)		1500 (cm^2) (2) **BUT if incorrect** idea that panel needs to be 2.5 x larger (1) **or** 30 x 20 x 2.5 (1)	2	**allow** full marks for correct answer with no working out **allow** 600 x 2.5 is **one mark only**

Question	Answer	Marks	Guidance
(b)		3	**PLEASE CHECK THE TABLE OF RESULTS FOR EVIDENCE OF USING THE DATA**
	no mark for yes or no		**ignore** yes or no
	(conclusion) correct up to 10 or 15 cm / correct for first 2 or 3 readings (1)		
	(conclusion) does **not** work above 15 cm / does not work for the last 4 readings (1)		
	OR		
	the conclusion is true for small distances but not true for larger distances / the conclusion is true for the first readings but not for the last readings (in the table) (2)		**allow only** works up to 10 or 15 cm / **only** works for the first 2 or 3 readings / ORA (2)
	AND		
	use one piece of data to support the conclusions (1)		examples of correct use of data: from 5cm to 10cm the current quarters / 120÷30 = 4 from 10cm to 20cm the current quarters / 30÷7.5 = 4 from 15cm to 30cm the current quarters / 13.3÷3.3 = 4.03 from 20cm to 40cm the current does not quarter / 7.5÷2.2 = 3.41 from 30cm to 60cm the current does not quarter / 3.3÷1.5 = 2.2 from 40cm to 80cm the current does not quarter / 2.2÷1.4 = 1.57 **allow** for a possible three marks the conclusion is true for some of the results but not all of them (1) one piece of data to support conclusion (1) one piece of data that does not support the conclusion (1)
	Total	**5**	

Question			Answer	Marks	Guidance
11	(a)		**Level 3 (5–6 marks)** States, with a reason for each one, how to dispose of all three types of radioactive waste. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** States, with a reason, how to dispose of one type of radioactive waste AND states how to dispose of the other two types of radioactive waste. **OR** States, with a reason for each one, how to dispose of two of the types of radioactive waste. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** States how to dispose any two of the types of radioactive waste. **OR** States, with a reason, how to dispose of one of the types of radioactive waste. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to C.** **Relevant scientific points for uranium could include** • store in (steel) drums / sealed in glass / buried deep underground • as only alpha emitted / radiation not very penetrating • long half-life / needs long term storage • very radioactive so may generate heat / need cooling **Relevant scientific points for iodine could include** • store in very thick walled containers / buried deep underground / behind several meters of concrete • as gamma is emitted / radiation is highly penetrating • as it has a short half-life it can be stored on the surface until most of the radiation has decayed • very radioactive so may generate heat / need cooling **Relevant scientific points for mixed waste could include** • can be placed in a land fill since it is not very radioactive • could be stored in very thick walled containers / buried deep underground / behind several meters of concrete • as gamma is emitted / radiation is highly penetrating • (but as it has a) short half-life it can be stored on the surface until most of the radiation has decayed Use the L1, L2, L3 annotations in scoris. Do not use ticks.

Question			Answer	Marks	Guidance
11	(b)	(i)	idea of tracers / measuring thickness (1)	1	**allow** placed inside patients to stop the growth of tissues or kill localised cancer cells or as a medical tracer **ignore** just to treat cancer / just (body)scans **allow** specific examples of gauging or controlling thickness e.g. paper / plastic / paint / aluminium foil / fabric seams
		(ii)	cancer treatment / idea of tracers / sterilisation (of surgical instruments) / kill microbes or bacteria (on food) (1)	1	**allow** radiotherapy ***/*** to detect leaks in pipes ***/*** gamma knife surgery ***/*** bone scans / PET scan / VACIS (to scan vehicles and containers for people hidden inside) **ignore** just (body) scans / to clean equipment or instruments / chemotherapy **not** sunbeds / X rays
			Total	**8**	

Question			Answer	Marks	Guidance
12	(a)		**any two marks from:** idea that gravity (attracts the comet to the Sun) (1) this causes it to accelerate (towards the Sun) (1) **BUT** (the closer the comet is to the Sun) the greater the gravitational force it experiences (2)	2	 **allow** because of gravity / gravitational force **not** gravitational potential energy / gpe **allow** the strength of gravity increases (closer to the Sun) (2)
	(b)		monitor to identify NEOs / track (the path of) the NEOs (1) deflect using explosives / change the path by using rockets or by colliding with the NEOs (1)	2	use a satellite / use a telescope is **not** sufficient **allow** observe with a telescope / use a satellite to detect NEOs **allow** idea of break up with explosives / blowing it up **ignore** just destroy or deflect them without a mechanism
			Total	**4**	

Question			Answer	Marks	Guidance
13	(a)		galaxies are moving away from the Earth (1)	1	**allow** galaxies are moving away from each other / galaxies are moving further away **ignore** universe is expanding
	(b)		galaxy **B** has a greater red shift (as it is further away from the Earth) / ORA (1) galaxy **B** has a greater speed than galaxy **A /** ORA (1)	2	**allow** idea that the greater the distance from Earth, the greater the red shift / ORA **allow** speed of galaxy increases with distance from Earth / ORA
			Total	**3**	

Question			Answer	Marks	Guidance
14	(a)		**either** as carbon dioxide levels increase so does the Earth's temperature / ORA (1) idea that peaks broadly coincide (1) **or** no direct link between Earth's temperature and carbon dioxide levels (1) idea that peaks do not coincide exactly (1)	2	no mark for yes or no on its own **allow** correct use of data from the graphs e.g. both graphs have their highest peaks at about 135 (thousands of years before present day) **allow** as carbon dioxide levels increase so does the change in the Earth's temperature / ORA **allow** graphs follow a similar pattern / graphs have similar fluctuations **allow** no exact match between surface temperature but the peaks or troughs broadly coincide (2) **allow** other gases contribute towards global warming
	(b)	(i)	22.9 (%) scores (2) **BUT if answer incorrect** $\frac{5729}{24983} \times 100$ (1)	2	**allow** correct answer with no working out for full marks **allow** 23 for **one mark only**

Question			Answer	Marks	Guidance
14	(b)	(ii)	**any three from:** idea of a general pattern that the greater the population the greater the carbon dioxide emissions / ORA (1) examples of countries that do not fit this pattern (1) MEDC (more economically developed countries) produce more carbon dioxide emissions than LEDC (less economically developed countries) (1) African countries produce small amounts of carbon dioxide (1) most countries carbon dioxide emissions exceed their populations in millions of tonnes (1) India, Ghana and Mozambique are the only countries where carbon dioxide emissions are less than the population in millions (1) the highest values of carbon dioxide per million is in industrialised (or developed) countries (1)	3	**allow** LEDC have less carbon dioxide emissions than their populations

Question			Answer	Marks	Guidance
	(c)		**any three from:** comment about which gas causes the greatest or least global warming with an explanation (1) reference to **two** of the following factors about **carbon dioxide** - least global warming potential, shortest lifetime but a highest current level (1) reference to **two** of the following factors about **methane** - has a higher global warming potential than CO_2 and longer lifetime than CO_2 but its current level is lower than CO_2 **OR** lower global warming potential than N_2O and longer lifetime than N_2O but its current level is higher than N_2O (1) reference to **two** of the following factors about **nitrous oxide** - has the greatest global warming potential and lifetime but the lowest current level (1)	3	
			Total	**10**	

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