OCR
Oxford Cambridge and RSA

GCSE

Chemistry A / Additional Science A

Unit **A172/02**: Modules C4, C5, C6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2017

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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 the detailed Mark Scheme:

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
(1)	separates marking points
not/reject	answers which are not worthy of credit
ignore	statements which are irrelevant - applies to neutral answers
allow/accept	answers that can be accepted
(words)	words which are not essential to gain credit
words	underlined words must be present in answer to score a mark
ecf	error carried forward
AW/owtte	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in RM Assessor to annotate scripts:

	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	no benefit of doubt
	reject
	correct response

L1 , L2 , L3	draw attention to particular part of candidate's response
^	information omitted

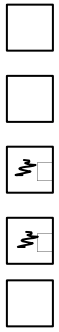
	indicate uncertainty or ambiguity
BOD	benefit of doubt
CON	contradiction
	incorrect response
ECF	error carried forward
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
NBOD	no benefit of doubt
R	reject
	correct response
	draw attention to particular part of candidate's response
^	information omitted

Subject-specific Marking Instructions

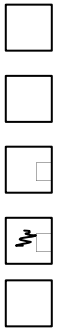
a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).

b. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

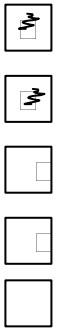
e.g. for a one-mark question where ticks in the third and fourth boxes are required for the mark:



This would be worth 1 mark.



This would be worth 0 marks.



This would be worth 1 mark.

c. The list principle:
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, e.g. one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

d. Marking method for tick-box questions:

If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.

If there is at least one tick, ignore crosses and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

e.g. if a question requires candidates to identify cities in England:

Edinburgh	
Manchester	
Paris	
Southampton	

the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			□			□	□	□	□	
Manchester	□	×	□	□	□				□	
Paris				□	□		□	□	□	
Southampton	□	×		□		□	□		□	
Score:	**2**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**NR**

e. For answers marked by levels of response:

i. Read through the whole answer from start to finish

ii. **Decide the level** that **best fits** the answer – match the quality of the answer to the closest level descriptor

iii. **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

iv. Use the **L1**, **L2**, **L3** annotations in RM Assessor to show your decision; do not use ticks.

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

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

Question			Answer	Marks	Guidance
1	(a)	(i)	lithium fluoride / LiF ; because the diagram shows one positive (ion) to one negative (ion) / equal numbers of positive and negative (ions) / one of each (type of) ion ; other salts do not have 1:1 ratio idea ;	3	**If incorrect compound chosen**, MP2 can still earn (1) if 1:1 ratio is identified **Accept** positive and negative atom/element for 'ion' **Ignore** 14 and 13
		(ii)	*Any 3 from :* *(movement ideas)* In solid ions cannot move/ fixed (place) / in solution ions can move (freely/about/around) ; ions in solid vibrate ; *(arrangement ideas)* ions in solid are arranged in a regular fashion/in a lattice/cubic/in rows / ions in solution are random ; ions in solid are packed together/close/no space between them/compact / ions in solution are spread out;	3	**Allow** particles for ions 'Ions move more in solution' is MP 1 only **Ignore** 'structure' or 'structured arrangement' alone
	(b)	**(i)**	(*l*) and (g) ;	1	Both needed in correct order **Do not allow** G but BOD L (difficult to tell)

		(ii)	*Any 2 from :* bonds (between atoms) do not break ; forces (between molecules/intermolecular forces) break/are overcome ; bonds (between atoms) are (always) strong / forces (between molecules) are (always) weak;	**2**	Mark independently **Allow** bonds are not affected/stay the same **Allow** 'bonds between molecules' **For MP3 ignore** idea that bonds/forces get weaker when liquids become gases **Ignore** discussion of energy
			Total	**9**	

Question			**Answer**	**Marks**	**Guidance**
2	(a)		*Any 2 from:* Reaction is displacement ; bromine reacts with (potassium) iodide / bromine gains electrons (from iodide) / bromine reacts to form (potassium) bromide ; iodine forms ;	**2**	Accept 'replacement' or 'takes the place of' **Do not allow** bromine gains electrons from potassium '**Bromine displaces iodine' is (2 marks)** for MP1 and MP3 **Accept** correct formulae for names of substances
	(b)	**(i)**	(element:) (both) contain all the same type of atoms / bromine only contains bromine (atoms) / iodine only contains iodine (atoms);	**1**	**Ignore** 'they only contain one element' (too close to question wording)
		(ii)	(diatomic:) (both) contain two/a pair of atoms (in each molecule)	**1**	

Question	Answer	Marks	Guidance
2 c	**[Level 3]** Describes two correct observations, including one correct equation OR describes one correct observation with both correct equations Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Gives either a correct observation or gives a correct equation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Gives a statement to describe an experiment. 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 may include:** **Equations** **NB** to 'count' equations must have all formulae correct (Br_2 / I_2 etc) Consider QWC impeded for unbalanced equations □ Cl_2 + 2KBr □ Br_2 + 2KCl □ Cl_2 + 2KI □ I_2 + 2KCl **Ignore** state symbols **Observations** □ chlorine + potassium bromide gives brown (solution) □ chlorine + potassium iodide gives brown (solution) **Accept** red-brown, (but not red alone), orange or yellow for both. **Level 1 experiments** □ add chlorine (water) to potassium bromide □ add chlorine (water) to potassium iodide **Ignore** incorrect colours or equations that are in addition to main answer. **Ignore** 'precipitate' QWC is impeded for incorrect terminology e.g. chlorine/chloride / stating products form as gases / incorrect formulae etc **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
		10	

Question			Answer	Marks	Guidance
3	(a)	(i)	6 (1)	1	
		(ii)	The all have similar properties / they are all non-metals / same number of electrons (6) in outer shell ; (1)	1	**Ignore** 'the same properties' **Ignore** reactivity
	(b)	(i)	Nitrogen: = 14 ; (1) Bromine: 81.25 / 81.3 / 81 ; (1) Working for one answer shown i.e. (nitrogen)(12 + 16) /2 OR (bromine) (35.5 + 127)/2 ; (1)	3	**For 3 marks** working for one must be shown
		(ii)	14 ; (1) 80 ; (1)	2	
		(iii)	(yes for N) because mean and relative atomic mass are the same / quotes 14 / masses are (exactly) the same for nitrogen; (1) (ignore decision for Br) mean is close to relative atomic mass / idea that it is (close but) not identical / quotes 81(.25) and 80 / differs by 1.25; (1)	2	**NB** 'mean' is answer to bi 'relative atomic mass' is answer to bii **Allow** ecf from bi and bii **Allow** 'yes, the relative atomic masses/answers/results are close / prediction close to actual' for (1) mark **OR** 'it works for nitrogen but not for bromine' for (1) mark

	(c)		*Any 2 from:* idea did not always work / idea did not work for all elements / mean relative atomic mass did not always match prediction ; mixed metals with non-metals ; more elements discovered (which did not fit pattern) / didn't leave gaps ; new theories fitted better / other scientists/Newlands (i.e. octaves)/Mendeleev had a new theory/new ideas/better ideas / Periodic Table was developed ;	**2**	**Ignore** 'not enough evidence / more evidence found' **Ignore** 'the elements in the triads did not have similar properties' (says in the stem that they do)
			Total	**11**	

Question	Answer	Marks	Guidance
4 a	**[Level 3]** Correctly links **two** test tube tests, reagents and results with the correct ion and makes **one** correct statement about the extra information from ion chromatography. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Correctly links **two** test tube tests and results with the correct ion OR makes **two** statements about the extra information from ion chromatography OR makes **one** correct statement about **each**. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Makes a statement about either the test-tube tests and results OR a statement about ion chromatography OR identifies the ions in the water. 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 may include: Extra** **information from ion chromatography** • shows amounts of ions • shows that water contains fluoride ions • shows that there is more chloride than other ions / correctly compares amounts of ions **Test tube tests and results** • test 1/adding acid shows carbonate by fizzing/making a gas/makes CO_2 (which turns lime water milky) • test 2/adding silver nitrate shows chloride by white precipitate • test 3/adding barium nitrate shows sulfate by white precipitate **Notes for level 1 only**: **Allow (2) marks** if chloride, carbonate and sulfate are identified as present. **Allow (1)** if two ions are identified as present **Consider QWC impeded** for technical term errors e.g. 'fluorine'/'fluorine ion' instead of 'fluoride' or 'chlorine' instead of 'chloride' **Consider QWC impeded** <u>if correct ions are identified</u> but test or observation is incomplete (e.g. 'it's a sulfate because it gives a white precipitate' or 'adding acid shows it is a carbonate') **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**

Question			Answer	Marks	Guidance
4	(b)		idea of matching/comparing (positions of) spectra/pattern/lines/wavelengths; (1) look up spectrum for an ion or element / (individual) elements or ions has its own (unique) spectrum/pattern/lines/wavelengths ; (1)	2	**Ignore** 'matching colours' **Ignore** idea that each line represents a different element
			Total	8	

Question			Answer	Marks	Guidance
5	(a)	(i)	*Any three from:*	3	If no other marks are given **Allow (1) mark** only for 'the more hydrogen (ions) the greater the temperature change (increase)'
			hydrochloric and/or nitric have one H atom in the formula /sulfuric acid has more (two) H atoms/ions in the formula;		**Allow** hydrochloric and/or nitric have fewer/less hydrogen atoms/ions in the formula ;
			acids with one hydrogen (atom/ion) give same temperature/change/5 (^{o}C) / **both** hydrochloric and nitric give the same temperature /change/5 (^{o}C);		
			sulfuric acid/the acid with two hydrogens gives a higher temperature/change/9.5(^{o}C);		
			sulfuric acid gives (almost) double the temperature (change) / the acid with 2 hydrogen (atoms/ions) give (almost) double the temperature (change);		MP4 includes MP3 and so scores (2)

		(ii)	<table><tr><th>variable</th><th>input variable</th><th>output variable</th><th>control variable</th></tr><tr><td>number of hydrogen atoms in formula of acid</td><td></td><td></td><td></td></tr><tr><td>volume of dilute sodium hydroxide</td><td></td><td></td><td></td></tr><tr><td>concentration of acid</td><td></td><td></td><td></td></tr><tr><td>Temperature</td><td></td><td></td><td></td></tr></table>	**3**	All correct (3) Three correct (2) One or two correct (1)
	(b)		neutralisation titration analysis exothermic corrosive	**2**	
	(c)		(all) <u>acids</u> contain H^+ (ions)/hydrogen <u>ions</u>; (1) (all) <u>alkalis</u> contain OH^- (ions)/hydroxide (ions); (1)	**2**	

	(d)		KOH ; (1) potassium sulfate / potassium sulphate; (1) K_2SO_4 ; (1)	**3**	**Allow** kOH (difficult to tell if K is a capital) but **do not allow** kOh **Allow** KHO etc **Allow** k_2SO_4 For both formulae… **Ignore** if charges on both ions are shown (consider as working) **Do not allow** one charge shown on complete formula e.g. $K_2SO_4^{2-}$ (consider as charged ion)
			Total	**13**	

Question			**Answer**	**Marks**	**Guidance**
6	(a)	(i)	Any 2 from: volume/amount/type of acid ; mass/amount/volume/size of pieces/surface area of zinc; temperature ;	**2**	 **Ignore** 'concentration of zinc' **Accept**: use the same (type of) catalyst / mass/amount/volume/size of pieces/surface area of catalyst;
	(ii)		hydrogen	**1**	

6 b	**[Level 3]** Makes a clear conclusion about both concentration and a catalyst and uses data to support one of the conclusions and identifies a limiting factor. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Makes a clear conclusion about the effect of either concentration or using a catalyst and uses data to support one of the conclusions. OR Makes a clear conclusion about the effect of either concentration or using a catalyst and identifies a limiting factor. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Makes a correct statement about conclusions or data. 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*** **Limiting factors** Identifies that at higher concentrations (1.0 M or higher) rate/time is not affected by increasing concentration Identifies that at higher concentrations rate/time is not affected by a catalyst all zinc is used up when 1.0M concentration or higher is used. **Data to support conclusions (values from the table must be quoted)** • Quotes (at least two) concentrations correctly linked to rate or time • Quotes (at least two) times at the same concentration with and without a catalyst OR works out the difference between times **Conclusions** • higher concentration, higher rate • higher concentration, less time taken • catalyst makes rate faster / faster reaction / shorter time Consider QWC impeded if terminology is incorrect e.g. incorrect units for time or concentration. **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**
	Total	**9**	

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