Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE In Chemistry
8CH0/01 Core Inorganic and
Physical Chemistry

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Summer 2017
Publications Code 8CH0_01_1706_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Acceptable Answer	Additional Guidance	Mark
1(a)(i)	A description that makes reference to the following points: • use of a nichrome / platinum wire / ceramic / silica rod **(1)** • use of (conc.) HCl/HCl(aq)/dilute HCl AND dip into the sample and place in / over a (blue) Bunsen burner flame **(1)**	Allow splint, spray method for both marks Reject just 'nichrome', nickel/chromium, inoculation loop, spatula, capillary tubing Reject other acids, just 'acid' Assume blue/roaring flame if not stated but reject use of yellow/safety flame	**(2)**

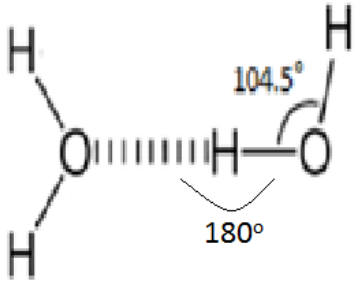
Question Number	Answer	Mark
1(a)(ii)	**1(a)(ii). The only correct answer is A** ***B*** *is not correct because this would give a red flame (brick red)* ***C*** *is not correct because this would give a red flame (carmine red)* ***D*** *is not correct because this would give a red flame (crimson red)*	**(1)**

Question Number	Answer	Mark
1(a)(iii)	**1(a)(iii). The only correct answer is C** ***A*** *is not correct because bromine is a brown gas, but bromide does not decompose to give it.* ***B*** *is not correct because nitrate(III) not nitrate(V) and does not give* NO_2 *by decomposing* ***D*** *is not correct because* O^{2-} *does not decompose in this way*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(b)	K_2CO_3 / $KHCO_3$ K^+ with any anion **(1)** CO_3^{2-} / HCO_3^- with any cation **(1)**	For 1 mark allow names Award 1 mark for a correct formula containing K^+, HCO_3^- or CO_3^{2-}, eg KCl, or Na_2CO_3 Award 1 mark for an incorrect formula containing both potassium and carbonate/hydrogencarbonate e.g. KCO_3 Do not award any marks for KCO_2 Ignore equations even if incorrect, but award marks for the compound as a reactant.	**(2)**

(Total for Question 1 = 6 marks)

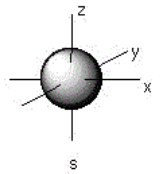
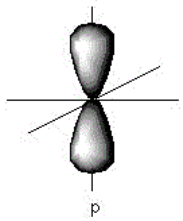
Question Number	Answer	Mark
2(a)(i)	**2(a)(i). The only correct answer is C** ***A*** *is not correct because oxygen does have a higher mass number but it is not the cause of polarity* ***B*** *is not correct because oxygen does have a larger atomic radius but it is not the cause of polarity* ***D*** *is not correct because oxygen does have more electrons but this is not the cause of polarity*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2 (a)(ii)	 • correct shape of two water molecules and hydrogen bond show at about 180 ° but not necessarily labelled **(1)** • HOH bond angle 104.5° and OHO angle 180° **(1)**	Allow about 10° tolerance by eye. Allow 104 – 105°	**(2)**

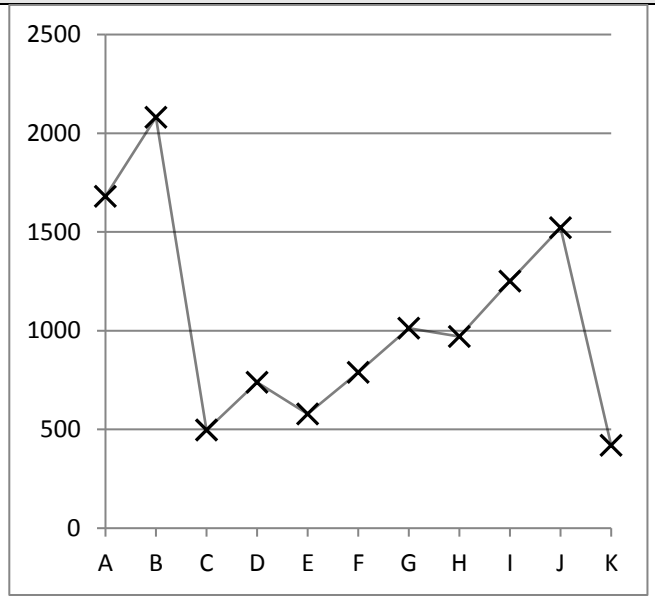
Question Number	Acceptable Answer	Additional Guidance	Mark
2 (a)(iii)	An explanation that makes reference to two of the following points: • more open / more space between molecules (making it less dense) **(1)** • due to (3 Dimensional) lattice / ring structure in ice **(1)** • hydrogen bonds longer than the covalent bonds **(1)**	Do not award MP1 if the gaps are full of air molecules May be shown as a diagram Allow reverse arguments for liquid water	**(2)**

Question Number	Answer	Mark
2 (b)	**2(b). The only correct answer is C** ***A*** *is not correct because barium hydroxide is the most soluble group 2 hydroxide* ***B*** *is not correct because calcium is below magnesium in the Periodic Table so this is more soluble* ***D*** *is not correct because group 1 hydroxides are very soluble compared to group 2 hydroxides*	**(1)**

(Total for Question 2 = 6 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
3 (a)	s-orbital circle or attempt at a sphere **(1)** p-orbital dumbbell type shape on any axis / any direction **(1)**	e.g.   Allow a diagram of 3 p-orbitals on the same set of axes or 3 separate p-orbitals on different axes Ignore 2 electrons per orbital Allow electron density map types	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3 (b)	An answer that makes reference to the following points: • makes mention of energy/enthalpy/(heat) energy/heat (change/required) AND to remove an electron **(1)** • one mole/1 mol **(1)** • makes mention of **gaseous atom(s)** (but not as the product of ionisation) **(1)** **ALTERNATIVE ANSWER** • energy change per mole / kJ mol^{-1} for **(1)** $X(\mathbf{g}) \rightarrow X^{+}(\mathbf{g}) + e^{(-)}$ • one mark for species **(1)** • one mark for correct state symbols **(1)**	IGNORE any references to standard conditions Do not award "Energy **given out**…" Do not award **Just** 'gaseous element'/ 'gaseous substance' Max 2 for $X(\mathbf{g}) + e^{(-)} \rightarrow X^{+}(\mathbf{g}) + 2\ e^{(-)}$	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3 (c)(i)	 G above F AND H between G and F **(1)** I above H and below A AND J above I and below B **(1)** K below C **(1)**	Points which are not joined with lines are perfectly acceptable. Do not penalise I below G if MP1 not awarded	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3 (c)(ii)	An explanation that makes reference to the following points: • D has one more proton / has a higher nuclear charge **(1)** • the electron being removed in C and D are from the same subshell / s-subshell / (s) orbital **(1)**	Allow same shell / energy level Allow the electron in D is closer to the nucleus than C / atomic radius decreases Ignore references to shielding, and full s-orbital which is more stable.	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3 (c)(iii)	An explanation that makes reference to the following points: • (the electron being removed from E) is from a new subshell / p-subshell / p-orbital **(1)** • which is more shielded from the nucleus than the s-subshell (from which the electron is removed in D) OR • which is further from the nucleus than the s-subshell / orbital (in E) **(1)**	Do not award 'in a new quantum shell' Allow electron removed from a higher energy level. Do not award clear reference to the outer electron in E being further from the nucleus than outer electron in D/atomic radius increasing from D to E Do not award clear reference to the outer electron in E being further from the nucleus than outer electron in D/atomic radius increasing from D to E	**(2)**

Question Number	Answer	Mark
3 (d)	**3(d). The only correct answer is C** ***A*** *is not correct because this does not show a large increase for the fourth ionisation so is not in Group 3* ***B*** *is not correct because it shows a large increase for the third ionisation so is in Group 2* ***D*** *is not correct because it is a Group 3 element as it has a large increase for the fourth ionisation but it has a first ionisation energy which is lower that C so it is below it in Group 3, so cannot be Boron*	**(1)**

(Total for Question 3 = 13 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (a)(i)	$Cl_2 + 2e^{(-)} \rightarrow 2Cl^-$	Allow multiples Ignore state symbols even if incorrect	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (a)(ii)	$Cl_2 + 4OH^- \rightarrow 2ClO^- + 2H_2O + 2e^{(-)}$	Allow multiples $Cl_2 + 2OH^- \rightarrow 2ClO^- + 2H^+ + 2e^{(-)}$ Ignore state symbols even if incorrect	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (a)(iii)	$Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$	Allow multiples Ignore state symbols even if incorrect Do not award mark if electrons are un-cancelled	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (a)(iv)	An explanation that makes reference to the following points: • (disproportionation is simultaneous) oxidation and reduction of an element (in the same species) **(1)** • chlorine changes from 0 to -1 **and** +1 **(1)**	Allow statement that chlorine is oxidised **and** reduced This can be shown on the equation in a(iii)	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (b)	ClO_3^- **(1)** (Cl is) **+**5 / 5**+** **(1)**	Allow $NaClO_3$ / $KClO_3$ Allow (+)V Do not award 5 unless +5/5+ seen in the formula or as a label on the formula	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (c)(i)	$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$	Allow multiples Ignore state symbols even if incorrect	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4 (c)(ii)	An answer that makes reference to the following points: • chlorine/bromine toxic/poisonous **(1)** • (Carry out the experiment in a) fume cupboard **(1)** OR • bromine corrosive **(1)** • wear gloves **(1)**	2nd mark dependent on first. Do not award harmful, but allow MP2 if correct for toxic.	**(2)**

(Total for Question 4 = 10 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
5 (a) (i)	$(1s^2)\ 2s^2\ 2p^6\ 3s^2$	ALLOW $1s^2$ repeated	**(1)**

Question Number	Answer	Mark
5 (a) (ii)	**5(a)(ii). The only correct answer is C** ***A*** *is not correct because this describes ionic bonding and magnesium has metallic bonding* ***B*** *is not correct because this describes covalent bonding and magnesium has metallic bonding* ***D*** *is not correct because this describes intermolecular forces and magnesium has metallic bonding*	**(1)**

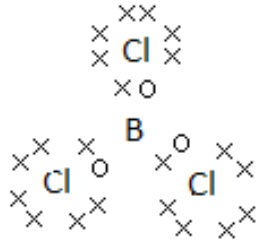
Question Number	Acceptable Answer	Additional Guidance	Mark
5 (b)	An answer that makes reference to the following points: Mass of an **atom** of an isotope **(1)** relative to 1/12th mass of an atom of carbon-12. **(1)** OR $\frac{\text{Mass of one atom of an isotope}}{\text{Mass of one atom of carbon-12}} \times 12$ **(2)**	Atom needs only to be mentioned in MP1. Reject just "average / mean mass of an atom" But allow "average / mean mass of an **atom** of an isotope" Ignore mention of moles throughout and 12g in respect to carbon-12.	**(2)**

Question Number	Answer	Mark
5 (c)	**5(c). The only correct answer is A** ***B*** *is not correct because this has 25 neutrons and not 13* ***C*** *is not correct because this has 13 protons and not 12* ***D*** *is not correct because this has 25 protons and not 12*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5 (d)	• calculates percentage of 3rd isotope **(1)** this is a standalone mark • lays out suitable equation including unknown **1)** • consolidates **(1)** • 24.0 **(1)**	Example of calculation (100 - (10.00 + 11.01)) = 78.99 $\frac{(78.99 \times \text{isotopic mass}) + (25.0 \times 10.00) + (26.0 \times 11.01)}{100} = 24.3$ 78.99 x isotopic mass = 1893.74 Isotopic mass = $\frac{1893.74}{78.99}$ = 24.0 (23.97443) must be 3 s.f Correct answer with some further working scores last 3 marks Correct answer with no working scores last mark Allow 24 provided there is clear calculation.	**(4)**

(Total for Question 5 = 9 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
6 (a) (i)	$2B + 3Cl_2 \rightarrow 2BCl_3$	Allow multiples Ignore state symbols even if incorrect	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6 (a) (ii)	 ALLOW All dots or all crosses	Ignore inner shell electrons and circles	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6 (a)(iii)	An explanation that makes reference to the following points: • 3 bonding pairs of electrons (bonding environments) (and no non-bonding / lone pairs of electrons in the outer shell of boron) **(1)** • (the bonding pairs of electrons) move apart to minimise repulsion **(1)**	 Accept 3 pairs of electrons Do not award 3 bonding pairs repel each other equally Accept move as far apart as possible / maximise separation	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6 (b)	Determine empirical formula finds mass of Cl AND finds moles of aluminium and chlorine **(1)** determines ratio and hence empirical formula is $AlCl_3$ **(1)**	<u>Example of calculation</u> 0.500 - 0.101 = 0.399(g) AND 0.101/27.0 = 0.00374074 / 3.74... x 10^{-3} AND 0.399/35.5 = 0.01123944 / 1.12... x 10^{-2} <u>0.01123944</u> = 3.005 0.00374074 Could use (0.101/0.5) x 100 = 20.2% 20.2/27.0 = 0.74814815 AND 79.8/35.5 = 2.2478873 <u>2.2478873</u> 0.74814815 = 3.005	**(6)**

	Determine molecular mass converts p into Pa / N m^{-2} and V into m^3 **(1)** rearrange $pV = nRT$ and finds number of moles **(1)** finds molecular mass **(1)** finds molecular formula **(1)**	p = 1.00 x 10^2 x 10^3 =100 000 / 1 x 10^5 AND V = 73.6 / 1 000 000 or 7.36 x 10^{-5} n = $\frac{100000 \times (73.6/1000000)}{8.31 \times 473}$ = 0.001872 or 1.872473 x 10^{-3} (mol) $M_r = \frac{0.500}{1.872473 \times 10^{-3}} = 267.03$ $\frac{267.03}{27.0 + (35.5 \times 3)} = 2$ so Al_2Cl_6 COMMENT MP 3-5 and identity of Al_2Cl_6 without incorrect working scores 6 marks	

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>*6 (c)</td>
<td>This question assesses a student’s ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for indicative content.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5–4</td><td>3</td></tr>
<tr><td>3–2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
</td>
<td>Guidance on how the mark scheme should be applied:

The mark for indicative content should be added to the mark for lines of reasoning.

For example, an answer with five indicative marking points, which is partially structured with some linkages and lines of reasoning, scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning).

If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).</td>
<td>(6)</td>
</tr>
</table>

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>*6 (c) contd</td><td>
The following table shows how the marks should be awarded for structure and lines of reasoning.
<table>
<tr><td></td><td>Number of marks awarded for structure of answer and sustained line of reasoning</td></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout.</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning.</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured.</td><td>0</td></tr>
</table>
Indicative content:
• aluminium and chlorine electronegativity difference 1.5 AND aluminium and fluorine electronegativity difference 2.5
• aluminium chloride (mostly) covalent / (small) molecule
• aluminium fluoride (bonds) more polar
• aluminium chloride molecular so weak(er) intermolecular forces / London forces
</td><td>
In general it would be expected that 5 or 6 indicative points would get 2 reasoning marks, and 3 or 4 indicative points would get 1 mark for reasoning, and 0, 1 or 2 indicative points would score zero marks for reasoning.

Reasoning marks may be reduced for extra incorrect chemistry

Allow all 3 electronegativity values / difference between F and Cl is 1 / difference between differences is 1/ F is 4, CL is 3 and this is a significant difference

Allow mostly/more ionic

Allow weak(er) dipole-dipole interactions
Do not award any suggestion of breaking covalent bonds
</td><td>(6)</td></tr>
</table>

	• aluminium fluoride is a giant structure/ strong electrostatic forces of attraction between the ions	Allow stronger dipole-dipole attractions	
	• more energy needed to break the stronger bonds to cause sublimation in aluminium fluoride	Allow (dative) covalent bonds breaking (to form small molecule / AlF_3)	

(Total for Question 6 = 16 marks)

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>7 (a)</td><td>
<table>
<tr><td>Titration</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Total Titre /cm^3</td><td>26.00</td><td>24.00</td><td>25.10</td><td>24.10</td><td>24.05</td></tr>
<tr><td>Concordant results (✓)</td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
</table>

Correct total titres (1)
Correct 3 ticks and mean titre = 24.05 (cm^3) (1)
Moles of sodium carbonate in 100 cm^3
AND
moles of sodium carbonate in 10 cm^3 (1)
Moles of HCl (1)
concentration of HCl (1)

</td><td>Allow lack of second decimal place 0, on one number only (as a slip)

<u>Example of Calculation</u>

Moles of sodium carbonate in 100 cm^3 = 1.30/106 = 0.012264151 (mol)

So moles of sodium carbonate in 10 cm^3 = 0.012264151/10
=0.0012264151 (mol)

Moles of HCl = 0.0012264151 x 2
= 0.0024528302

So concentration of HCl = 0.0024528302 / (24.05/1000) = 0.1019887
= 0.102 (mol dm^{-3})(to 3 s.f.)
Allow 0.10 provided working given which is equal to 0.10 to 2 s.f.
Correct final answer with alternative route scores 3 marks
Allow TE on incorrect mean titre</td><td>(5)</td></tr>
</table>

Question Number	Answer	Mark
7 (b)	**7(b). The only correct answer is C** ***A*** *is not correct because this is the reverse of the correct colour change* ***B*** *is not correct because this is doing the reverse titration (acid in flask and carbonate in burette)* ***D*** *is not correct because this is going beyond the endpoint to an acidic solution*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7 (c)	An explanation that makes reference to the following two points: Add drop by drop AND So that too much acid is not added / to avoid 'overshooting' the end-point **(1)** Swirl / shake / agitate AND To ensure a homogenous mixture/allow all acid and alkali to react **(1)** Any one from: Rinse the sides of the flask with distilled/deionised water between additions AND To rinse all reactants into the solution so all can react	If no other mark awarded, award 1 for three correct actions Do not award to make the reading more precise / accurate (as this is given in the question) Do not award ensuring the burette is vertical measuring to the bottom of the meniscus parallax errors reducing the speed of the titration fewer drops of indicator	**(3)**

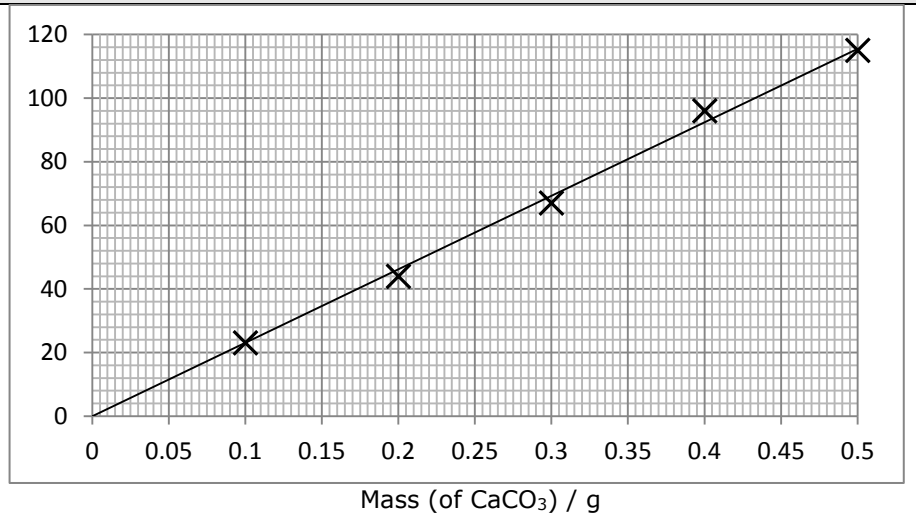
	OR Use a white tile/paper AND To clearly see change of colour OR Compare the colour of the solution at the end-point with previous titrations AND To ensure consistency of end-point colour OR Rinse the end of the jet of the burette (with distilled water) AND To ensure all the hydrochloric acid is in the conical flask (no drip left on burette **(1)**		

(Total for Question 7 = 9 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (a) (i)	$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$ Balanced equation **(1)** State symbols **(1)**	Accept $CaCO_3(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$ 2nd mark dependent on first or near miss. Reject $H_2CO_3(aq)$ in equation, but allow state symbol mark if otherwise correct.	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (a) (ii)	Finds molar mass of calcium carbonate	<u>Example of calculation</u> Mr of calcium carbonate $= 40.1 + 12 + (16 \times 3) = 100.1$ ($g\ mol^{-1}$) Allow $= 40 + 12 + (16 \times 3) = 100$ ($g\ mol^{-1}$) Accept answer with no working	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (a)(iii)	• calculate moles of calcium carbonate in 0.50 g **(1)** • moles of hydrochloric acid in 20 cm^3 AND Show the hydrochloric acid is in excess with appreciation of 2:1 ratio in equation for reaction **(1)**	<u>Example of calculation</u> moles of calcium carbonate = 0.50/100.1 = 0.004995 = 0.0050 (mol) moles of hydrochloric acid in 20 cm^3 = 20/1000 x 2 = 0.040 (mol) 0.04 (moles of hydrochloric acid) reacts with 0.02 (moles of calcium carbonate) therefore the acid is in (a four times) excess. OR 0.0050 (moles of calcium carbonate) reacts with 0.010 (moles of hydrochloric acid) therefore the acid is in (a four times) excess Ignore calculations using other masses of calcium carbonate	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (b) (i)	Points plotted accurately AND axes labelled **(1)** Points plotted must cover more than half of graph paper AND Reasonable straight line of best fit which may extend to the origin **(1)** Allow ecf on reasonable line on incorrectly plotted points.	Do not award for reversed axes 	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (b) (ii)	Straight line through the origin (therefore volume is directly proportional to mass)	Allow 'There is a positive correlation.'	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (c)	Either • finds gradient from graph **(1)** • molar volume given to 2 s.f. with units **(1)** OR • moles of calcium carbonate **(1)** • molar Volume **(1)**	Example calculation Gradient = $\frac{\text{volume}}{\text{mass}}$ = 231 (cm^3 per gram) Allow correctly calculated values in the range = 210 to 250 (Molar Volume = Gradient x Mr) Molar Volume = 231 x 100.1(or x 100) = 23 (dm^3) (must be 2 s.f) Answer to 2 s.f. (and units) Allow TE from any gradient OR Data may be used from any experiment number eg using data from Experiment 5 Moles of calcium carbonate = 0.50/100.1 = 0.0050 Molar Volume = 115/0.005 = 23 (dm^3) Allow data from a point on the line calculated using route 2	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8 (d)	To saturate the solution with CO_2 / to stop the CO_2 formed from dissolving		**(1)**

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

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