# GCE AS MARKING SCHEME

**SUMMER 2019**

**AS**
**CHEMISTRY - COMPONENT 1**
**B410U10-1**

## INTRODUCTION

This marking scheme was used by WJEC for the 2019 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

**COMPONENT 1: THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS**

**SUMMER 2019 MARK SCHEME**

**GENERAL INSTRUCTIONS**

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark, apart from extended response questions where a level of response mark scheme is applied.

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Extended response questions

A level of response mark scheme is applied. The complete response should be read in order to establish the most appropriate band. Award the higher mark if there is a good match with content and communication criteria. Award the lower mark if either content or communication barely meets the criteria.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Marking abbreviations

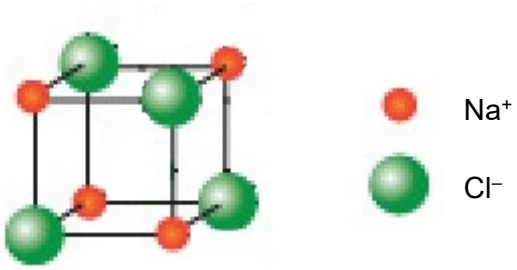
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

**Section A**

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **1** | | | | $3p^6 4s^2 3d^{10} 4p^6$ | | 1 | | 1 | | |
| **2** | | | | $^{28}_{14}$Si | | 1 | | 1 | | |
| **3** | *(a)* | | | (molecules are) polar if their atoms have different electronegativities / different tendencies to attract electrons in a bonded pair | 1 | | | 1 | | |
| | *(b)* | | | $\delta-$ $\delta+$<br>F—F F—Cl | 1 | | | 1 | | |
| **4** | | | | Halogen chlorine<br>Use (water) sterilisation (1) **both** needed<br><br>Halide fluoride<br>Use in toothpaste / water supply to prevent tooth decay<br>(1) **both** needed | 2 | | | 2 | | |
| **5** | | | | any value > 500 but < 1000 | | | 1 | 1 | | |

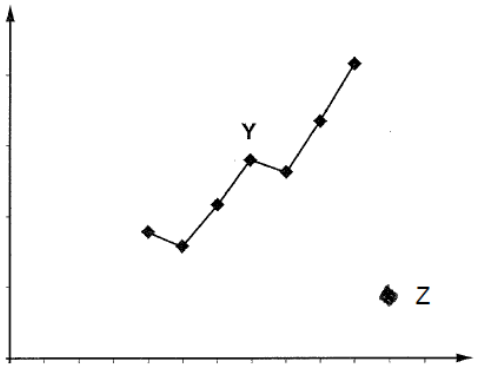
| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **6** | | | | diagram to show face centred cubic structure of $Na^+$ and $Cl^-$<br>(ions on minimum of 2 faces)<br><br>e.g.<br>  <br> | 1 | | | 1 | | |
| **7** | | | | $K_c = \frac{[AB_2]}{[A][B]^2}$ (1)<br><br>$1.47 = \frac{0.4}{0.2[B]^2}$<br><br>$[B] = 1.17$ (mol $dm^{-3}$) (1)<br><br>no ECF from incorrect $K_c$ expression | | 2 | | 2 | 2 | |
| | | | | **Section A total** | **5** | **4** | **1** | **10** | **2** | **0** |

**Section B**

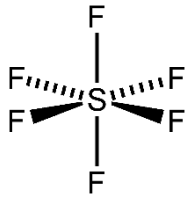
| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **8** | *(a)* | | | the Periodic Table has the elements arranged by increasing number of protons (1)<br><br>the (atomic) masses are due to protons **and** neutrons (1)<br><br>in argon there are more atoms with greater number of neutrons (1) | | | 3 | 3 | | |

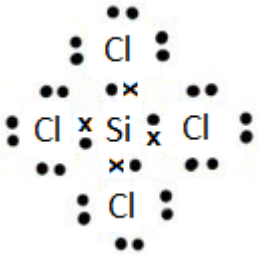
| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | *(b)* | (i) | | **Indicative content**<br>• element is vaporised<br>• ionised by having electron knocked off / electron gun<br>• forms positive ions<br>• accelerated by charged plates<br>• made into stream by slits<br>• deflected by electromagnet<br>• degree of deflection according to m/z<br>• detected<br>• range of magnetic fields<br>• whole system under vacuum | 6 | | | 6 | | |
| | | | | **5-6 marks**<br>All stages mentioned with some explanation of what happens at each stage and where each stage occurs<br>*The candidate constructs a relevant, coherent and logically structured method including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary is used accurately throughout.*<br><br>**3-4 marks**<br>Most stages mentioned with some attempt at explaining what happens at each stage or where each stage occurs<br>*The candidate constructs a coherent account including most of the key elements of the indicative content. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary are generally sound.*<br><br>**1-2 marks**<br>Some stages mentioned with limited description of what happens where<br>*The candidate attempts to link at least two relevant points from the indicative content. Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.*<br><br>**0 marks**<br>*The candidate does not make any attempt or give an answer worthy of credit.* | | | | | | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | | (ii) | | $\frac{(15 \times 20) + (5 \times 21)}{20}$ (1)<br><br>accept any correct abundance ratio<br><br>20.25 / 20.3 (1) | | 2 | | 2 | 2 | |
| | | (iii) | | $^{20}T^{2+}$ | | | 1 | 1 | | |
| | | | | **Question 8 total** | **6** | **2** | **4** | **12** | **2** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **9** | *(a)* | | | $X(g) \rightarrow X^{+}(g) + e$<br><br>**must** include state symbols | 1 | | | 1 | | |
| | *(b)* | (i) | | increasing number of protons present (in the nucleus) / greater nuclear charge (1)<br><br>greater attraction therefore more energy is needed to remove electron (1)<br><br>ignore references to shielding | 2 | | | 2 | | |
| | | (ii) | | Group 5 (1)<br><br>(small) fall to the next element / Group 6 element as a paired electron is being removed (1)<br><br>do **not** award explanation mark if incorrect group given | | 2 | | 2 | | |
| | | (iii) | | **Z** marked below level of all other points e.g.<br><br>  <br> | | | 1 | 1 | | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | *(c)* | (i) | | award (1) for either of following<br><br>• the number of particles in 1 mol<br>• the number of $^{12}C$ atoms in 12 g of carbon-12 | 1 | | | 1 | | |
| | | (ii) | | 34.23 g is 0.1 mol (1)<br><br>this has $6.02 \times 10^{22}$ particles (1)<br><br>each $Al_2(SO_4)_3$ contains 12 oxygen atoms therefore number of oxygen atoms is $7.22 \times 10^{23}$ (1) | | 3 | | 3 | 3 | |
| | | | | **Question 9 total** | **4** | **5** | **1** | **10** | **3** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **10** | *(a)* | | | precipitate of barium sulfate forms with barium chloride (1)<br><br>none with magnesium chloride as magnesium sulfate is appreciably soluble (1)<br><br>award (1) for either of following equations<br><br>$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$<br><br>$BaCl_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2HCl(aq)$ | | 3 | | 3 | | 3 |
| | *(b)* | | | there are 6 bond pairs (1)<br><br>these repel to maximum separation / minimum repulsion (1)<br><br>award (1) for 3D diagram to show octahedral structure e.g.   | 3 | | | 3 | | |
| | *(c)* | | | electrons are excited by electricity (1)<br><br>promoted to a higher energy level (1)<br><br>then fall back (to lower level) and give out energy (1)<br><br>the energy emitted is in the yellow part of the visible spectrum (1) | 4 | | | 4 | | |
| | | | | **Question 10 total** | **7** | **3** | **0** | **10** | **0** | **3** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **11** | *(a)* | (i) | | award (1) for four bonding pairs<br>award (1) for octet around all chlorine atoms e.g.<br>  <br> | | 2 | | 2 | | |
| | | (ii) | | 109° / 109.5° | 1 | | | 1 | | |
| | | (iii) | | $SiCl_4(l) + 2H_2O(l) \rightarrow SiO_2(s) + 4HCl(aq)$<br><br>award (1) for all formulae correct<br>award (1) for correct balancing and state symbols | | | 2 | 2 | | 2 |
| | | (iv) | | $SiCl_4$ is a simple (covalent) molecule (1)<br><br>$SiO_2$ is a giant (covalent) molecule (1)<br><br>$SiCl_4$ has weak intermolecular forces (1)<br><br>strong covalent bonds need to be broken to melt $SiO_2$ (1) | 4 | | | 4 | | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | *(b)* | (i) | | pH = – log [$H^+$] (1)<br>0.22 (1) | 1 | 1 | | 2 | 2 | |
| | | (ii) | | $1.26 \times 10^{-7}$ | | 1 | | 1 | 1 | |
| | | (iii) | | lower pH means that [$H^+$] has gone up / is higher than expected (1)<br>equilibrium has moved to RHS (1)<br>forward reaction must be endothermic (1) | | | 3 | 3 | | |
| | *(c)* | | | theoretical yield = $\frac{5}{24.3}$ × 22.4 = 4.61 (1)<br>percentage purity = $\frac{4.31}{4.61}$ × 100 = 93.5% (1)<br>accept alternative method<br>award (1) for actual **or** theoretical number of moles of hydrogen<br>• actual n($H_2$) = $\frac{4.31}{22.4}$ = 0.192 mol<br>• theoretical n($H_2$) = $\frac{5}{24.3}$ = 0.206 mol<br>percentage purity = $\frac{0.192}{0.206}$ × 100 = 93.2% (1) | | 2 | | 2 | 2 | 2 |
| | | | | **Question 11 total** | **6** | **6** | **5** | **17** | **5** | **4** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **12** | *(a)* | (i) | | (+)5 | | 1 | | 1 | | |
| | | (ii) | | $n(NaClO_3) = 0.826$ (1)<br>$n(O_2) = 0.826 \times 1.50 = 1.239$ (1)<br>$V = \frac{nRT}{p} = \frac{1.239 \times 8.31 \times 600}{1.01 \times 10^5} = 61.2\ dm^3$ (1) **must** be to 3 sig figs<br>accept molar volume method<br>$V = \frac{1.239 \times 22.4 \times 600}{273} = 61.0\ dm^3$ (1) **must** be to 3 sig figs | | 2 | 1 | 3 | 3 | |
| | *(b)* | | | $M_r(NaClO) = 74.5$<br>total $M_r$ of reactants = 151.02 (1) **both** needed<br>atom economy = $\frac{74.5}{151.02} \times 100 = 49.3\,\%$ (1) | | 2 | | 2 | 1 | |
| | *(c)* | | | $\frac{18.8}{23} : \frac{29.0}{35.5} : \frac{52.2}{16}$<br>0.817 : 0.817 : 3.27 (1)<br>1 : 1 : 4<br>therefore empirical formula is $NaClO_4$ (1) | | 2 | | 2 | 1 | |
| | | | | **Question 12 total** | **0** | **7** | **1** | **8** | **5** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **13** | *(a)* | | | to remove **insoluble / solid** impurities | 1 | | | 1 | | 1 |
| | *(b)* | | | ($250cm^3$) volumetric flask | 1 | | | 1 | | 1 |
| | *(c)* | | | to show the end-point | 1 | | | 1 | | 1 |
| | *(d)* | | | as many as needed until two/three concordant titres are obtained (to ensure correct answer) | 1 | | | 1 | | 1 |
| | *(e)* | | | $BaCO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + CO_2(g) + H_2O(l)$ | | 1 | | 1 | | |
| | *(f)* | | | n(HCl) = $\frac{250}{1000} \times 0.5 = 0.125$ mol | | 1 | | 1 | | |
| | *(g)* | | | number of moles HCl neutralised in each titration<br><br>= $27.8 \times \frac{0.1}{1000} = 2.78 \times 10^{-3}$ mol (1)<br><br>number of moles HCl left after reacting with ore<br>= $2.78 \times 10^{-3} \times 10 = 2.78 \times 10^{-2}$ mol (1)<br><br>therefore number of moles neutralised by ore<br>= $0.125 - 2.78 \times 10^{-2} = 0.0972$ mol (1) | | | 3 | 3 | 3 | 3 |
| | *(h)* | | | number of moles $BaCO_3 = \frac{0.0972}{2} = 0.0486$ mol (1)<br><br>mass barium in ore = $0.0486 \times 137 = 6.66$ g (1)<br><br>percentage barium = $\frac{6.66}{19.15} \times 100 = 34.8\%$ (1) | | 3 | | 3 | 3 | 3 |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | *(i)* | | | insoluble barium compound (e.g. barium sulfate) could have been present | | | 1 | 1 | | 1 |
| | | | | **Question 13 total** | **4** | **5** | **4** | **13** | **6** | **11** |

## COMPONENT 1: THE LANGUAGE OF CHEMISTRY, STRUCTURE OF MATTER AND SIMPLE REACTIONS

## SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

| Question | AO1 | AO2 | AO3 | Total | Maths | Prac |
|---|---|---|---|---|---|---|
| Section A | 5 | 4 | 1 | 10 | 2 | 0 |
| 8 | 6 | 2 | 4 | 12 | 2 | 0 |
| 9 | 4 | 5 | 1 | 10 | 3 | 0 |
| 10 | 7 | 3 | 0 | 10 | 0 | 3 |
| 11 | 6 | 6 | 5 | 17 | 5 | 4 |
| 12 | 0 | 7 | 1 | 8 | 5 | 0 |
| 13 | 4 | 5 | 4 | 13 | 6 | 11 |
| Totals | 32 | 32 | 16 | 80 | 23 | 18 |