# GCE AS MARKING SCHEME

**SUMMER 2018**

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

**INTRODUCTION**

This marking scheme was used by WJEC for the 2018 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

## 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.

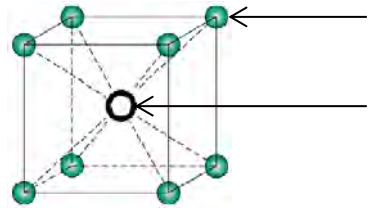
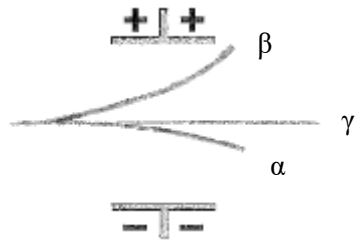
Marking abbreviations

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.** | $3s^2 3p^6 4s^2 3d^{10} 4p^5$ | | 1 | | 1 | | |
| **2.** | +6 | 1 | | | 1 | | |
| **3.** |  chloride ion / $Cl^-$<br>caesium ion / $Cs^+$ | 1 | | | 1 | | |
| **4.** | 1 mol calcium sulfate contains 4 mol oxygen atoms (1)<br>$0.4 \times 6.02 \times 10^{23} = 2.41 \times 10^{23}$ (1) | | 2 | | 2 | 1 | |
| **5.** |  <br>α deflected towards negative, β deflected towards positive and γ not deflected (1)<br>β deflected more than α (1) | 2 | | | 2 | | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **6.** | | | | $2CH_3COOH + ZnO \rightarrow (CH_3COO)_2Zn + H_2O$ | | 1 | | 1 | | |
| **7.** | | | | relative masses 180.12 and 92.12 calculated (1)<br><br>92.12/180.12 × 100 = 51% (1) | | 2 | | 2 | 1 | |
| | | | | **Section A total** | **4** | **6** | **0** | **10** | **2** | **0** |

**Section B**

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **8.** | (a) | | | ice is less dense / molecules are further apart (1)<br>ice is a hydrogen bonded lattice (1)<br>(partially) broken down in water (1) | 1<br>1 | <br><br>1 | | <br><br>3 | | |
| | (b) | | | two isotopes – chlorine-35 and chlorine-37 in 3:1 ratio (1)<br>lines at 70, 72 and 74 (1)<br>ratio 9:6:1 (1) | <br><br>3 | | | <br><br>3 | | |
| | (c) | | | red in HCl because it has very low pH / pH 1 **and**<br>orange in $C_2H_5COOH$ because it has a higher pH / pH 2/3 (1)<br>HCl is a strong acid and $C_2H_5COOH$ is weak (1)<br>comparison of degree of dissociation and $H^+$ concentration (1) | 1<br>1 | | <br><br>1 | <br><br>3 | | 1 |
| | | | | **Question 8 total** | **7** | **1** | **1** | **9** | **0** | **1** |

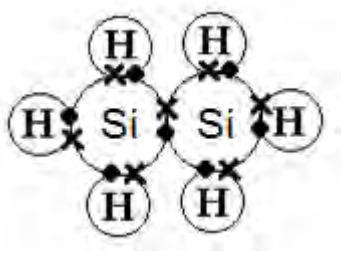
| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **9.** | (a) | | | **Indicative content**<br>Student incorrect because<br>• covalent bonds are **not** broken<br>• intermolecular forces are broken on boiling<br>• in bromine and hydrogen these are van der Waals forces<br>• these are due to temporary dipole-temporary dipole attractions<br>• boiling temp $Br_2$ > boiling temp $H_2$ since $Br_2$ has more electrons<br>• hydrogen bromide is polar and therefore has permanent dipole interactions<br>• permanent dipole attractions are stronger than van der Waals forces<br>• based on boiling temperatures of $Br_2$ and HBr, the larger size has more effect than the polarity in these examples | | 3 | 3 | 6 | | |

**5-6 marks**
Understanding that it might be expected that HBr would have a higher boiling temperature than $Br_2$
*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.*

**3-4 marks**
Reference to temporary dipole attractions (in $H_2$ / $Br_2$) and permanent dipole attractions (in HBr); stronger forces between $Br_2$ molecules than $H_2$ molecules
*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.*

**1-2 marks**
Understanding that covalent bonds are not broken; reference to breaking of intermolecular forces
*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.*

**0 marks**
*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 |
| | (b) | (i) | |  <br>shared pair of electrons between Si atoms (1)<br>rest of electrons correct (1) | | 2 | | 2 | | |
| | | (ii) | | 109° to 110° (1)<br>repulsion of 4 pairs of electrons (1) | 1 | 1 | | 2 | | |
| | | | | **Question 9 total** | **1** | **6** | **3** | **10** | **0** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **10.** | (a) | (i) | | add (dilute nitric) acid | | 1 | | 1 | | 1 |
| | | (ii) | | any soluble sulfate e.g. sodium sulfate, magnesium sulfate | 1 | | | 1 | | 1 |
| | | (iii) | | $Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$<br>all species correct (1) state symbols (1) | 1 | 1 | | 2 | | |
| | | (iv) | | filter (1)<br>washed to remove **soluble** impurities (1)<br>dry to constant mass to ensure all water removed (1) | 3 | | | 3 | | 3 |
| | (b) | (i) | | moles $PbSO_4$ = 3.56/303 = 0.0117 mol (1)<br>mass Pb = $0.0117 \times 207 = 2.43$ g (1)<br>percentage = $2.43/4.52 \times 100 = 54\%$ (1) | | 3 | | 3 | 2 | |
| | | (ii) | | 0.281% - accept 0.28% | | 1 | | 1 | 1 | 1 |
| | (c) | | | measure the volume of carbon dioxide produced when acid added / measure the loss in mass when heated (1)<br>if other carbonate present will be more moles of carbonate present (than calculated from this volume/mass) (1) | | | 2 | 2 | | |
| | | | | **Question 10 total** | **5** | **6** | **2** | **13** | **3** | **6** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **11.** | (a) | | | dilute by factor of 40 (1)<br><br>use pipette and volumetric flask (1)<br><br>suitable size of volumetric flask and pipette (1) | 1 | | 1<br><br>1 | 3 | 1 | 3 |
| | (b) | | | moles HCl = $\frac{19.6 \times 0.05}{1000} = 9.8 \times 10^{-4}$ (1)<br><br>moles $Ca(OH)_2$ in 25.0 $cm^3$ = $\frac{9.8 \times 10^{-4}}{2} = 4.9 \times 10^{-4}$ (1)<br><br>conc $Ca(OH)_2$ = $4.9 \times 10^{-4} \times 40 = 0.0196$ mol $dm^{-3}$ (1)<br><br>$= 0.019 \times 74 = 1.45$ g $dm^{-3}$ (1) | | 4 | | 4 | 3 | |
| | (c) | | | white precipitate / gone cloudy (1)<br><br>$CO_2$ absorbed and $CaCO_3$ formed / water from saturated solution evaporates and $Ca(OH)_2$ precipitates (1) | 2 | | | 2 | | 2 |
| | (d) | | | greater volume of acid needed because $Ba(OH)_2$ is more soluble than $Ca(OH)_2$ | | | 1 | 1 | | |
| | (e) | | | flame test (1)<br>calcium (brick) red **and** barium (apple) green (1)<br><br>**OR**<br>add aqueous solution of named soluble sulfate (1)<br>heavier / more white precipitate for $Ba^{2+}$ (1) | 2 | | | 2 | | 2 |
| | | | | **Question 11 total** | **5** | **4** | **3** | **12** | **4** | **7** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **12.** | (a) | | | a reaction in which products react to form reactants (as well as reactants reacting to form products) | 1 | | | 1 | | |
| | (b) | | | both lines starting as curves and then being horizontal at same time as original (1)<br><br>line **A** starting at 2.5 and finishing at 0.5 (1)<br><br>line **B** starting at 0 and finishing at 2.0 (1) | | | 3 | 3 | 2 | |
| | (c) | (i) | | $K_c = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$ (1)<br><br>no units (must follow $K_c$) (1) | | 2 | | 2 | 1 | |
| | | (ii) | | ΔH approx = 0 (1)<br><br>explanation in terms of le Chatelier's principle (1) | | 1 | 1 | 2 | | |
| | (d) | | | pH = $-\log[H^+]$ (1)<br><br>$[H^+] = 3.98 \times 10^{-3}$ mol $dm^{-3}$ (1) | 1 | 1 | | 2 | 2 | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | (e) | | | moles of $CH_3COOH$ = 2.94/60 = 0.049 **and**<br>moles $C_2H_5OH$ = 0.045 (1)<br><br>moles ethanol is limiting factor (1)<br><br>theoretical yield $CH_3COOC_2H_5$ = 0.045 × 88 = 3.96 g (1)<br><br>percentage yield = 2.73/3.96 × 100 = 68.9 % (1) | 1 | 3 | | 4 | 2 | |
| | | | | **Question 12 total** | **3** | **7** | **4** | **14** | **7** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **13.** | (a) | | | absorb carbon dioxide in alkali (1)<br><br>absorb water in (conc) sulfuric acid /<br>suitable anhydrous substance / condense water (1) | | | 2 | 2 | | 2 |
| | (b) | | | mass C = $12.57 \times \frac{12}{44} = 3.43$<br>mass H = $7.74 \times \frac{2}{18.02} = 0.86$ (1)<br><br>percentage C = 3.43/6.57 × 100 = 52.2%<br><br>percentage H = 0.86/6.57 × 100 = 13.1% (1)<br><br>percentage O = 100 – (52.2 + 13.1) = 34.7 (1) | | 3 | | 3 | 2 | |
| | (c) | | | C:H:O = $\frac{52.2}{12} : \frac{13.1}{1.01} : \frac{34.7}{16} = 4.35 : 13.1 : 2.17$ (1)<br><br>C:H:O $\Rightarrow$ 2:6:1<br><br>empirical formula is $C_2H_6O$ (1) | | 2 | | 2 | 1 | |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| | (d) | | | $n = \frac{PV}{RT}$ (1)<br><br>conversion of volume to $m^3$ **and** pressure to Pa (1)<br><br>$n = \frac{103 \times 10^3 \times 6.02 \times 10^{-3}}{8.31 \times 373} = 0.200$ (1)<br><br>$M_r = \frac{9.20}{0.200} = 46$ (1)<br><br>**OR**<br><br>conversion of volume to STP<br><br>× 273/373 (1)<br>× 103/101 (1)<br><br>V = 4493 $cm^3$ (1)<br><br>$M_r = \frac{9.20 \times 24000}{4493} = 49$ (1) | 1 | 2 | 1 | 4 | 3 | |
| | (e) | | | $M_r$ calculated in *(d)* is the same as $M_r$ for the empirical formula therefore the molecular formula is $C_2H_6O$ | 1 | | | 1 | | |
| | | | | **Question 13 total** | **2** | **7** | **3** | **12** | **6** | **2** |

## 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 | 4 | 6 | 0 | 10 | 2 | 0 |
| 8. | 7 | 1 | 1 | 9 | 0 | 1 |
| 9. | 1 | 6 | 3 | 10 | 0 | 0 |
| 10. | 5 | 6 | 2 | 13 | 3 | 6 |
| 11. | 5 | 4 | 3 | 12 | 4 | 7 |
| 12. | 3 | 7 | 4 | 14 | 7 | 0 |
| 13. | 2 | 7 | 3 | 12 | 6 | 2 |
| Totals | 27 | 37 | 16 | 80 | 22 | 16 |