# GCE AS MARKING SCHEME

**SUMMER 2016**

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

## INTRODUCTION

This marking scheme was used by WJEC for the 2016 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.

## AS CHEMISTRY

## SUMMER 2016 MARK SCHEME

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

## 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.** | | | | $(1s^2 2s^2)2p^6 3s^2 3p^6 4s^2 3d^3$ / $(1s^2 2s^2)2p^6 3s^2 3p^6 4s^2 3d^3 4s^2$ | | 1 | | 1 | | |
| **2.** | | | | Diagrams to show<br>Two atoms of sodium with 1 electron, one atom of sulfur with 6 electrons **and** arrows showing electron transfer (1)<br><br>2 sodium ions with 1+ charge and 1 sulfur ion with 2– charge (1)<br><br>If inner shells shown they **must** be correct | | 2 | | 2 | | |
| **3.** | | | | $^{23}_{11}Na$ | | 1 | | 1 | | |
| **4.** | | | | S is oxidised from –2 to 0 and reduced from +4 to 0 | | 1 | | 1 | | |
| **5.** | | | | The number of particles in 1 mole / number of particles in 12g of $^{12}C$ | 1 | | | 1 | | |
| **6.** | | | |  <br>Accept any orientation | 1 | | | 1 | | |
| **7.** | | | | $M_r$ aspirin and reagents 180 and 240.12 (1)<br><br>Atom economy = 180/240.12 × 100 = 75 (%) (1) | | 2 | | 2 | 2 | |
| **8.** | | | | (Bonds are polar if) the elements/atoms involved have a difference in electronegativity | 1 | | | 1 | | |
| | | | | **Section A total** | **3** | **7** | **0** | **10** | **2** | **0** |

**Section B**

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **9.** | *(a)* | | | Average mass of an atom (1)<br>On a scale where 1 atom of $^{12}C$ has a mass of 12 (1) | 2 | | | 2 | | |
| | *(b)* | (i) | | Magnet labelled | 1 | | | 1 | | |
| | | (ii) | | Atoms are bombarded by high energy electrons/ electron gun (1)<br>Electrons knocked off / positive ions formed (1) | 2 | | | 2 | | |
| | *(c)* | | | 8 % of $^{6}Li$ and 92 % $^{7}Li$ (1)<br>$A_r = \frac{(8 \times 6) + (92 \times 7)}{100} = 6.92$ (1) | | 2 | | 2 | 2 | |
| | *(d)* | | | Line drawn at 81 with height approx same as that at 79 (1)<br>Lines at 158 and 162 with approx same height (1)<br>Line at 160 with height approx double that of 158 and 162 (1) | | 3 | | 3 | 3 | |
| | | | | **Question 9 total** | **5** | **5** | **0** | **10** | **5** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **10.** | *(a)* | | | Diagram or description of face centred cubic for NaCl (1)<br>Diagram or description of body centred cubic for CsCl (1)<br>Co-ordination 6:6 in NaCl and 8:8 in CsCl (1)<br>$Cs^+$ bigger than $Na^+$ so more $Cl^-$ can fit round the metal ion (1) | 4 | | | 4 | | |
| | *(b)* | | | Any **four** of following – 4 max<br>(For a liquid to boil) intermolecular bonds/forces must be broken (1)<br>$H_2O$ held together by hydrogen bonds (1)<br>S less electronegative (1)<br>$H_2S$ held together by van der Waals forces (1)<br>Van der Waals forces are weaker than hydrogen bonds (1) | | 4 | | 4 | | |
| | *(c)* | | | $PCl_6^-$ is octahedral and $PCl_4^+$ is tetrahedral – credit diagram (1)<br>Bonds angles of 90° and 109–110° (1)<br>(Due to presence of ) 6 bond pairs and 4 bond pairs (1)<br>Arranged to give minimum repulsion/ maximum separation (1) | 1<br>1<br>1 | 1 | | 4 | | |
| | | | | **Question 10 total** | **7** | **5** | **0** | **12** | **0** | **0** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **11.** | *(a)* | | | **X** is $Ba^{2+}$/Ba (allow $Sr^{2+}$/Sr) (1)<br><br>**Y** is $Mg^{2+}$/Mg (allow $Ca^{2+}$/Ca) (1)<br><br>**X** forms insoluble sulfate <u>and</u> **Y** forms insoluble hydroxide / sulfates become less soluble and hydroxides become more soluble down the group (1) | | | 3 | 3 | | 3 |
| | *(b)* | (i) | | $\mathbf{X}^{2+}(aq) + SO_4^{2-}(aq) \rightarrow \mathbf{X}SO_4(s)$ | | 1 | | 1 | | 1 |
| | | (ii) | | $\mathbf{Y}^{2+}(aq) + 2OH^-(aq) \rightarrow \mathbf{Y}(OH)_2(s)$ | | 1 | | 1 | | 1 |
| | *(c)* | (i) | | Orange/brown is bromine/ iodine (1)<br><br>Reaction is redox/ displacement (1)<br><br>Anion is $Br^-/I^-$ (1) | | 1 | 1<br><br>1 | 3 | | 3 |
| | | (ii) | | Add $Ag^+(aq)$/ $AgNO_3(aq)$ (and nitric acid) (1)<br><br>For $Br^-$<br>Gives cream precipitate, partially soluble in $NH_3$<br>For $I^-$<br>Gives yellow precipitate, insoluble in $NH_3$ (1) | 1 | | 1 | 2 | | 2 |
| | | | | **Question 11 total** | **1** | **3** | **6** | **10** | **0** | **10** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **12.** | *(a)* | | | **Indicative content**<br><br>Not an absorption spectrum/ is an emission spectrum<br>(It is not atoms) but electrons that are excited<br>(Electrons) go to higher energy levels<br>Then they fall back (to lower energy levels)<br>They emit energy<br>Sodium spectrum has more than one line<br><br>The flame colour is yellow because the energy emitted is in the yellow part of the visible spectrum<br><br>Series of lines that come closer together (with increase in energy involved) | 3 | | 3 | 6 | | |
| | | | | ***5*-6 marks**<br>States that the spectrum is a series of converging lines, each caused by different electron transitions<br>*The candidate constructs a relevant, coherent and logically structured account including key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.*<br>**3- 4 marks**<br>States that it is an emission spectrum and that excited electrons emit energy on falling back to lower energy levels<br>*The candidate constructs a coherent account including many 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 is generally sound.*<br>**1-2 marks**<br>Recognises that electrons are excited and then fall back<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>**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 |
| **12.** | *(b)* | | | Sample onto flame test wire / damp splint and placed in a **blue** flame (1)<br><br>Flame colourless for magnesium and lilac for potassium (1) | 2 | | | 2 | | 2 |
| | *(c)* | (i) | | Energy = hc/$\lambda$ (1)<br><br>Energy = $\frac{6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{500 \times 10^{-9}} = 3.98 \times 10^{-19}$ (1)<br><br>Unit J (1) | 1 | 2 | | 3 | 3 | |
| | | (ii) | | Ultraviolet region | 1 | | | 1 | | |
| | | | | **Question 12 total** | **7** | **2** | **3** | **12** | **3** | **2** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **13.** | *(a)* | (i) | | $Na_2CO_3$ + 2HCl → 2NaCl + $CO_2$ + $H_2O$ | | 1 | | 1 | | |
| | | (ii) | I | 0.1 mol $dm^{-3}$ HCl needs 0.05 mol $dm^{-3}$ $Na_2CO_3$ (1) | | 1 | | | | |
| | | | | Use of volumetric flask (250/500/1000 $cm^3$) (1) | 1 | | | | | |
| | | | | $M_r$ 106 so need to dissolve approx 5.3 g $Na_2CO_3$ $dm^{-3}$ (1) | | 1 | | 3 | 1 | 3 |
| | | | II | Pipette 20/25 $cm^3$ of either solution (1) | 1 | | | | | |
| | | | | Use of acid/base indicator / named acid/base indicator (1) | | 1 | | | | |
| | | | | End-point at colour change (1) | | 1 | | 3 | | 3 |
| | *(b)* | | | pH = –log[$H^+$] (1) | 1 | | | | | |
| | | | | pH = 0.96 (1) | | 1 | | 2 | 2 | |
| | *(c)* | (i) | | (Filtered), washed and dried (1) | | 1 | | | | |
| | | | | Washed to remove **soluble** impurities/ remove acid<br>Accept heated to constant mass to ensure all water removed (1) | | | 1 | 2 | | 2 |
| | | (ii) | | $Ag^+(aq)$ + $Cl^-(aq)$ → AgCl(s) | | 1 | | 1 | | 1 |
| | | (iii) | | Mass silver = 108/143.5 × 0.93 (1) | | | | | | |
| | | | | % silver = 0.70/2.48 = 28.2 (%) (1) | | 2 | | 2 | 2 | 2 |
| | | | | **Question 13 total** | **3** | **10** | **1** | **14** | **5** | **11** |

| Question | | | | Marking details | Marks available | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AO1 | AO2 | AO3 | Total | Maths | Prac |
| **14.** | *(a)* | | | $K_c$ = $\frac{[CH_3COOCH_3][H_2O]}{[CH_3COOH][CH_3OH]}$ | 1 | | | 1 | | |
| | *(b)* | | | Moles $CH_3COOH$ = 0.220 | | 1 | | 1 | | 1 |
| | *(c)* | | | Use of $x^2$ ($x$ = ester and water) (1)<br><br>5.47 = $\frac{x^2}{0.12 \times 0.22}$ (1)<br><br>$x$ = 0.38 (mol) (1) | | 1<br><br>1 | 1 | 3 | 3 | |
| | *(d)* | | | Reaction had not reached equilibrium | | | 1 | 1 | | 1 |
| | *(e)* | | | To avoid loss of reagents | 1 | | | 1 | | 1 |
| | *(f)* | (i) | | Water is added during titration (1)<br><br>(If left too long) ester would be hydrolysed/ reverse reaction would occur (1) | | | 2 | 2 | | 2 |
| | | (ii) | | $K_c$ decreases because lower concentration/ fewer moles of ester (or more moles acid and alcohol) | | | 1 | 1 | | |
| | *(g)* | | | $K_c$ decrease means equilibrium moved to LHS (1)<br><br>Reaction is exothermic (1) | | 1 | 1 | 2 | | |
| | | | | **Question 14 total** | **2** | **4** | **6** | **12** | **3** | **5** |

## SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

| Question | AO1 | AO2 | AO3 | Total | Maths | Prac |
|---|---|---|---|---|---|---|
| Section A | 3 | 7 | 0 | 10 | 2 | 0 |
| 9. | 5 | 5 | 0 | 10 | 5 | 0 |
| 10. | 7 | 5 | 0 | 12 | 0 | 0 |
| 11. | 1 | 3 | 6 | 10 | 0 | 10 |
| 12. | 7 | 2 | 3 | 12 | 3 | 2 |
| 13. | 3 | 10 | 1 | 14 | 5 | 11 |
| 14. | 2 | 4 | 6 | 12 | 3 | 5 |
| | | | | | | |
| Totals | 28 | 36 | 16 | 80 | 18 | 28 |