# Mark Scheme (Results)

# Summer 2018

Pearson Edexcel GCSE
Combined Science – Paper 4
Chemistry 2 (1SC0_2CH)

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**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 have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

| Assessment Objective | | Command Word | |
|---|---|---|---|
| Strand | Element | Describe | Explain |
| AO1* | | An answer that combines the marking points to provide a logical description | An explanation that links identification of a point with reasoning/justification(s) as required |
| AO2 | | An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding | An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding) |
| AO3 | 1a and 1b | An answer that combines points of interpretation/evaluation to provide a logical description | |
| AO3 | 2a and 2b | | An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning |
| AO3 | 3a | An answer that combines the marking points to provide a logical description of the plan/method/experiment | |
| AO3 | 3b | | An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning |

*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(a) | An explanation linking<br><br>• (Earth) cooled / temperature decreased (1)<br><br>• (water vapour / steam) condensed / oceans formed (1) | allow temperature of atmosphere/ Earth decreased<br><br>allow it rained (and formed oceans)<br>allow lakes/seas | **(2)**<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(b)(i) | final answer of 20 (%) with or without working (2)<br><br>volume gas used = 50-40 (1)<br>$\qquad$ (= 10 (cm$^3$) )<br><br>percentage = (50-40)/50 x 100  (1)<br>$\qquad$ = 20 (%) | allow ecf throughout<br><br>allow 40-50 (1) (= -10cm$^3$)<br><br><br>allow 40/50 x 100 = 80% (1)<br>then 100 − 80 = 20% (1)<br><br>if no other marks awarded<br>allow 10/50 = 0.2 (1) | **(2)**<br>AO 2 2 |

| Question Number | Answer | Mark |
|---|---|---|
| 1(b)(ii) | C      the gas has expanded when it is hot<br><br>**The only correct answer is C**<br><br>*A* is not correct because this is not true<br><br>*B* is not correct because this is not relevant<br><br>*D* is not correct because this is not true | **(1)**<br>AO 2 2 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(c) | An explanation linking<br><br>• oxygen increased (in atmosphere) (1)<br><br><br>• (oxygen) {reacts / combines} with iron (sulphide) / iron is oxidised (1) | allow oxygen appears (1)<br>photosynthesis produces oxygen (1)<br><br><br>ignore oxygen reacts with <u>rocks</u> / sulfur <u>in rocks</u> replaced by oxygen / oxygen enters <u>rocks</u> / iron ore | **(2)**<br>AO 2 1 |

**(Total for Question 1 = 7 marks)**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(i) | 35 | reject 35.5 | (1)<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(a)(ii) | 2.8.7 | allow any separator including gaps e.g. 2 8 7<br><br>send to review any diagrams | (1)<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(b) | A description to include<br><br>• (blue litmus) (first turns) red (1)<br><br>• (then) bleaches / turns white (1) | allow shades of red and pink but not other colours *e.g.* red-purple<br><br>allow colour disappears/goes colourless<br>ignore yellow/colour fades/discolours<br><br>white then red = 0; just 'goes white' = 1 | (2)<br>AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(c)(i) | A description to include<br><br>• shared **electron**(s) (1)<br><br>• {a pair of / two} (**electrons**) (1) | allow a diagram for both mark points<br><br>reference to ionic bonding/ions scores 0<br>*e.g.* gains two electrons = 0 | (2)<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(c)(ii) | An explanation linking any two from<br><br>• intermolecular forces / forces **between** molecules (1)<br><br>• (intermolecular) forces {weak / take little energy to break}/ little energy to separate molecules  (1)<br><br>• boiling point is below room temperature / has a low boiling point (1) | if answer relates to the breaking of any type of **bond** first two marking points cannot be scored (but 3rd could)<br><br>allow 'attractions' instead of 'forces' | **(2)**<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(d) | (the solution is) acid(ic) / contains {hydrogen ions/ H+} | allow pH < 7<br>allow hydrogen chloride is acidic<br><br>if incorrect identity of acidic solution then 0 marks (*e.g.* chlorine is acidic = 0) | **(1)**<br>AO 2 1 |

**(Total for Question 2 = 9 marks)**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(a) | Na : O<br><br>$\dfrac{0.92}{23}$ : $\dfrac{0.32}{16}$ (1)<br><br><br>0.04 : 0.02<br>OR 2 : 1 (1)<br><br><br>(empirical formula from ratio) $Na_2O$ (1) | formula alone scores 0<br><br><br><br>2$^{nd}$ MP is either for working out correct number of moles OR for finding the correct ratio by dividing by the smaller number from an incorrect first step<br><br>3$^{rd}$ MP is for correctly converting a ratio to a formula with whole numbers only<br><br>example<br>$\dfrac{23}{0.92}$ : $\dfrac{16}{0.32}$<br><br>25 : 50 (0)<br><br>1 : 2 (1)<br><br>$NaO_2$ (1) | (3)<br>AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(b) | $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$<br><br>2 Na (1)<br>2 NaOH (1)<br>s, l, aq, g (1) | <br><br><br><br><br>allow S, L, AQ, G<br>ignore words | (3)<br>AO 2 1 |

| Question Number | Answer | Mark |
|---|---|---|
| 3(c) | **C** is the most reactive<br><br>**The only correct answer is C**<br><br>**A** is not correct because this is irrelevant<br><br>**B** is not correct because this is irrelevant<br><br>**D** is not correct because this is irrelevant | **(1)**<br>AO 2 1 |

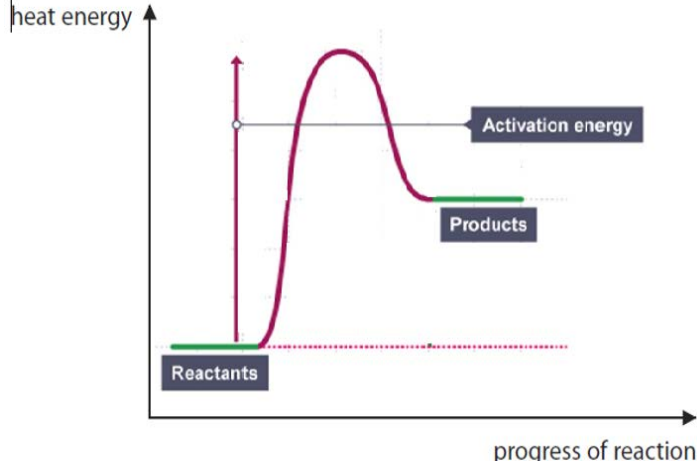| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(d) | An explanation linking<br><br>• atoms become larger/**outer** electron becomes further from the nucleus / ORA (1)<br><br><br><br><br><br>• so **outer** electron more easily **lost** / less energy needed to **lose outer** electron / ORA (1) | allow atomic radius increases / increased shielding effect (by inner complete(electron) shells)/ more (inner) shells/ decreased force of attraction between outer shell electron and nucleus / correct electronic configuration**s** (at least two)<br><br>reject 'more outer shells' / incorrect forces such as intermolecular | **(2)**<br>AO 1 1 |

**(Total for Question 3 = 9 marks)**

| Question Number | Answer | Mark |
|---|---|---|
| 4(a) | **D** the viscosities increase<br><br>**The only correct answer is D**<br><br>**A** is not correct because average number of carbon atoms increases<br><br>**B** is not correct because ease of ignition decreases<br><br>**C** is not correct because boiling points increase | **(1)**<br>AO 1 1 |

| Question Number | Answer | Mark |
|---|---|---|
| 4(b)(i) | **D** $C_nH_{2n+2}$<br><br>**The only correct answer is D**<br><br>**A** is not correct because this is the general formula of an alkene<br><br>**B** is not correct because this is not the general formula of an alkane<br><br>**C** is not correct because this is not the general formula of an alkane | **(1)**<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(b)(ii) | An explanation linking<br><br>• (compounds) containing **hydrogen** and **carbon** (atoms) (1)<br><br><br>• only (1)<br><br>MP2 is dependent on MP1 | reject carbon molecules and hydrogen molecules /mixtures of carbon and hydrogen<br><br>ignore symbols C and H | **(2)**<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(c) | An explanation including<br><br>• boiling points increase as the number of carbon atoms (per molecule) increases (1)<br><br><br>• because {stronger forces between molecules / (increased / more) intermolecular forces (1) | ignore {positive correlation alone / proportional} allow 'longer chain' for more C atoms<br><br>reject any reference to 'bonds' for MP2<br><br>allow van der Waals' forces/London forces | **(2)**<br>AO 3 1a<br>AO 3 1b |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(d)(i) | fuel oil | | **(1)**<br>AO 3 2a |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(d)(ii) | • reactant(s) and product(s) labelled in their correct positions (1)<br><br><br><br><br><br><br><br><br>• activation energy labelled (1)<br><br><br><br>• energy of reactants lower than energy of products (1) | example of diagram<br><br><br>ignore arrow heads<br><br><br><br>allow unlabelled diagram of an endothermic reaction showing the basic outline shape<br><br>if exothermic reaction profile shown, allow (1) for reactants and products in correct position and (1) for correct labelling of activation energy | (3)<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 4(d)(iii) | $C_6H_{14}$ | | (1)<br>AO 2 1 |

**(Total for Question 4 = 11 marks)**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(a) | A description including the following points :<br><br>• (potassium bromide solution) colourless (1)<br><br>• (mixture) turns yellow / brown / orange / red (1) | ignore clear<br>ignore reference to colour of chlorine water /change in colour<br><br><br>allow colour combinations *e.g.* yellow-orange<br>reject additional incorrect observations for MP2 but ignore yellow/orange/red/brown vapours | **(2)**<br>AO 1 2 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(b)(i) | An explanation linking<br><br>• (chlorine) gains (an) electron(s) (1)<br><br><br><br>• to form {a chloride (ion) / Cl$^-$ / negative ion} (1)<br><br>MP2 dependent on MP1 | reject chlorine gains an electron from potassium<br>reject sharing of electrons<br><br>allow Cl$_2$ + 2e → 2Cl$^-$ even if unbalanced (2)<br><br>ignore chlorine ion | **(2)**<br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(b)(ii) | 2Br$^-$ → Br$_2$ + 2e (2)<br><br>correct species (in correct place) (1)<br>balancing of correct species (1) | allow<br>2Br$^-$- 2e → Br$_2$ (2)<br>unbalanced 1 max<br><br>allow multiples | **(2)**<br>AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(c) | $2Al + 3Cl_2 \rightarrow 2AlCl_3$ (3)<br><br><br>LHS (1)<br>RHS (1)<br>balancing of correct formulae (1) | penalise the use of 'CL' or 'AL' once only<br>ignore state symbols<br>allow multiples<br>ignore use of capital L for MP3 | **(3)**<br>AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 5(d) | A description to include the following points<br><br>• insert electrodes (into aqueous solution)(1)<br><br>• connect to electrical supply /powerpack /battery/cell (1)<br><br><br>• bulb lights / ammeter shows current / electrolyte decomposes (1) | first two marks can be given for a suitable diagram<br><br>allow anode **and** cathode<br><br>allow carry out an electrolysis experiment alone / see if solution conducts electricity (1)<br>allow pass an electric current through (the solution) (1)<br>ignore electricity alone<br><br>allow correct observation at one electrode (1) | **(3)**<br>AO 3 3a |

**(Total for Question 5 = 12 marks)**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a)(i) | (gas) syringe / graduated tube / burette (instead of measuring cylinder) | | (1) AO 3 3b |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a)(ii) | final answer in range 0.44 – 0.52 inclusive with or without working (2)<br><br>If answer not in range:<br>difference in volume = $\underline{(43 - 15)}$      (1)<br>difference in time      (60 – 0)<br>                  = 0.47   /   0.467   (1) | allow ecf throughout where values are less than 1 (1 max)<br><br><br>use of inverted gradient expression giving 2.27 – 1.92 scores 1 mark (evidence of working required) | (2) AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(a)(iii) | steeper **curve** to the left of printed curve and same final volume | line must not go above 40 $cm^3$ and curve back down | (1) AO 2 2 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(b)(i) | number of moles = 0.1 /24 = 0.0042 or 4.2 x $10^{-3}$ (1) | ignore answer left as fraction 1/240<br><br>rounding must be correct:<br>reject 0.00416 (no dot)<br>allow 0.0041$\dot{6}$ (with dot above the 6)<br>allow 0.004 | (1) AO 2 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 6(b)(ii) | the equation shows two HCl reacting with one Mg | allow ratio is 2:1<br>allow 1 mol HCl reacts with 0.5 mol of Mg<br>allow 0.5 mol HCl reacts with 0.25 mol Mg | **(1)**<br>AO 2 1 |

| Question Number | Indicative content | Mark |
|---|---|---|
| *6(c) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>• reactions occur when particle collisions have sufficient energy (activation energy)<br>• reaction rates are increased when the energy collisions is increased<br>• and / or the frequency of collisions is increased<br>• two factors in the reaction have been changed (temperature and concentration of one of the reactants)<br><br>• experiment 2 was carried out at a higher temperature than experiment 1<br>• concentrations of reactant are the same in experiment 1 and 2<br>• particles have more (kinetic energy), so move faster<br>• so there are more frequent collisions between particles in solution **A** solution and solution **B**<br>• collisions will also occur with greater energy<br>• so more collisions will have the minimum activation energy to react when they collide<br>• so greater frequency of successful collisions (so decreased reaction time/increased rate in experiment 2 compared to experiment 1)<br><br>• experiment 3 was carried out at a higher concentration than experiment 2/ a fourfold increase<br>• temperatures of the reactants are the same in experiment 2 and 3<br>• there are more reacting particles in the same volume of reaction mixture<br>• so there are more frequent collisions between particles in solution **A** and solution **B**<br>• so greater frequency of successful collisions (so decreased reaction time/increased rate in experiment 3 compared to experiment 2)<br><br>• reaction rate in experiment 3 is greatest due to combined effects of increased temperature and increased concentration | **(6)**<br>AO 2 2<br>AO 3 2a |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1-2 | • Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3)<br>• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) |
| Level 2 | 3-4 | • Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3)<br>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) |
| Level 3 | 5-6 | • Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3)<br>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) |

**(Total for Question 6 = 12 marks)**