Pearson Edexcel

Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCSE
In Combined Science (1SC0)
Paper 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

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Question number	Answer	Additional guidance	Mark
1(a)	6 or 7 points plotted correctly (2) or 4 or 5 points plotted correctly (1) best fit curve starting at (0,0) (1)	allow +/- half a square for MP3, curve must be a single smooth curved line going through most or all of THEIR plotted points (ecf allowed), or if the points are not visible, through most or all of the correct values reject curves going above or below 100cm^3 by more than half a square reject straight line / dot to dot straight lines bar charts – max 2 marks for plotting points if time value is clear	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
1(b)(i)	13	answer may be given in table	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation linking	Note: a comparison of the rate of marble chips with that of marble powder is ignored ignore anything about rate increasing at the beginning / starts fast	**(3)** **AO3-2**
	• rate of reaction decreases / reaction is slow**er** (1)	allow (rate of) reaction slows down ignore references to volumes of gas produced ignore reaction stops	
	• as {reactants /acid/ marble chips} are used up (1)	allow {concentration/amount} of acid decreases / marble chips getting smaller allow {marble chips <u>have</u> / acid <u>has</u>} react**ed** allow less {reactants/ marble chips/ acid} available ignore limiting factor/ reaction is ending	
	• so less frequent collisions (1)	allow fewer (successful) collisions ignore less particles have less energy	

Question number	Answer	Additional guidance	Mark
1(c)	graph to show	there must be a line from part (a) to award these marks if lines are not labelled, make a reasonable assumption about which is C mark independently.	**(2)** **AO3-2**
	• initial line steeper and to the left (1)	line should start from start of original line	
	• line levelling off at 100 cm^3 before 5 minutes (1)	all levelling off within half a square of original line	

Question number	Answer	Additional guidance	Mark
2(a)	An explanation linking • 1 <u>electron</u> (1) • in outer shell(s) (1)	 allow 1 is the last number of the electronic configuration (1) ignore electronic configurations written out reject incorrect number of electrons MP2 depends on MP1 for outer allow {highest energy / last} for shell allow ring, energy level, orbital allow: 1 outer electron (2) 1 valence electron (2) have to lose 1 electron to get full outer shell (2) same number of electrons in outer shell (1) forms a +1 ion by losing one electron (1)	**(2)** **AO1-1**

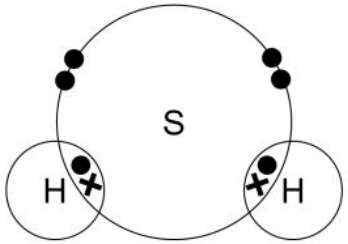
Question number	Answer	Mark
2(b)	**C** soft enough to be cut by a knife / low melting point is the only correct answer **A** and **D** are incorrect because alkali metals do not have a high density **B** is incorrect because alkali metal compounds are not blue in colour	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
2(c)	2 K(s) + $Br_2(g)$ $\rightarrow$ 2 KBr(s) balancing (1) state symbol s (1)	allow multiples ignore 'two' ignore 'solid'	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
2(d)(i)	An explanation linking • (atoms) {of same element / with same number of protons} / all contain 19 protons / same atomic number (1) • different number of neutrons / different mass number / have 20, 21, 22 neutrons (1)	reject compound/ molecule/ ion / element**s** once allow same protons ignore electrons reject different protons allow different / extra / more / fewer neutrons ignore different mass / relative atomic mass reject different electrons	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
2(d)(ii)	39.1348/39.135/ 39.13/ 39.1 with or without working scores 2 93.25 x 39 + 40 x 0.02 + 6.73 x 41 = 3913.48 (1) $\frac{3913.48}{100}$ = 39.1348 (1) OR $\frac{39 \times 93.25}{100}$ and $\frac{0.02 \times 40}{100}$ and $\frac{6.73 \times 41}{100}$ (1) 36.3675 + 0.008 + 2.7593 = 39.1348 (1)	Final answer of 39 with no working scores 0. Final answer of 39 rounded from correct working scores 2. allow rounding of values in the 3 sums allow ecf for MP2 if transcription error(s) e.g 93.52 allow ecf for MP2 if formula is correct but error in calculation	**(2)** **AO2-1**

Question number	Answer	Mark
3(a)	**B** carbon dioxide is the only correct answer **A**, **C** and **D** are incorrect because the gas thought to be the highest percentage in the Earth's early atmosphere is carbon dioxide	**(1)** **AO3-2b**

Question number	Answer	Additional guidance	Mark
3(b)	 (2) OR one shared pair of electrons between S atom and each of two H atoms (1) rest of molecule correct (1)	for any marks must be molecule with two H and one S atom, but ignore shape/ bond angles unlabelled atoms can be assumed to be H and S max 1 mark if charge on molecule allow dots or crosses or a mixture of both allow with no circles ignore inner shells even if incorrect MP2 dependent on MP1	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
3(c)	An explanation linking any 3 from: • **sulfur/ S** (is present as an impurity) (1) • (when fuel burns) {impurity/sulfur} is {burned/ combusted/ oxidised/ reacts with oxygen} (1) • sulfur dioxide/ SO_2 (formed) (1) • sulfur dioxide dissolves in {rain/ water/ clouds} (1) • sulfuric acid is formed (1)	ignore any references to nitrogen oxides/ nitric acid $S + O_2 \rightarrow SO_2$ scores MP1, MP2 and MP3 allow sulfur dioxide <u>reacts</u> with {rain/ water/ clouds} ignore sulfur dioxide mixes with {rain/ water/ clouds} allow forms sulfurous acid. suitable equation forming H_2SO_3 or H_2SO_4 scores MP3, MP4 and MP5	**(3)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(d)(i)	pH meter	allow pH probe allow universal indicator/ UI reject any other indicators ignore pH paper/ pH strips/ pH scale/ pH indicator	**(1)** **AO3-3a**

Question number	Answer	Additional guidance	Mark
3(d)(ii)	An explanation linking one pair from : • use {sulfuric / sulfurous} acid (rather than hydrochloric acid) (1) • because acid rain contains {sulfuric / sulfurous} acid / does not contain hydrochloric acid (1) OR • use rainwater rather than pure water (1) • because rainwater {does not have a pH 7 of / is not pure water} (1) OR • use acid with a higher pH / a pH between pH 4 and pH 6 (1) • because acid rain has a higher pH than 2 (1)	allow formulae allow use a less concentrated acid allow use a range of pH values (1) so that the effect of different pH can be found (1) allow a specific control variable e.g: kept at same light levels (1) because the plants may grow faster in different light conditions (1) ignore: use more plants/ use a variety of plants / leave for a longer time / have several sets of the experiment / repeat the experiment / water every day	**(2)** **AO3-3b**

Question number	Answer	Mark
4(a)(i)	**C** oxidising, harmful and hazardous to the environment is the only correct answer **A**, **B** are incorrect because none of the substances are flammable **D** is incorrect because the third symbol does not mean corrosive	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An explanation linking one pair from: • use a fume cupboard (1) • because (**chlorine/it)** is a toxic gas (1) OR • wear gloves/ goggles/ safety glasses (1) • because the concentrated **hydrochloric acid** is corrosive (1) OR • do not dispose of any reactants / products down the drain (1) • because {**potassium manganate/ chlorine /it**} is hazardous to the environment (1)	mark independently ignore any other suggestions not included in markscheme ignore masks/ breathing apparatus/ well ventilated room allow poisonous allow acids 'burns' skin/ eyes allow dispose of substances correctly allow specific hazards e.g. kills fish	**(2)** **AO2-2**

Question number	Answer	Additional guidance	Mark
4(b)	so {gas / chlorine} moves (from flask) to gas jar	ignore to deliver substances ignore to connect the apparatus / to stop gas escaping	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
4(c)	An explanation linking: • **chlorine** will turn the damp litmus paper (red then) white / bleached (1) • so that you can see when the jar is full (1)	reject chloride once reject bleaches then turns red for MP1 allow so you know {when to stop the reaction/ when enough chlorine has been made}/ to detect chlorine / to show that chlorine has been made / to see if chlorine is escaping allow gas for chlorine in MP2 reject to test pH for MP2	**(2)** **AO2-2**

Question number	Answer	Additional guidance	Mark
4(d)	$2KMnO_4 + 16HCl \rightarrow 2MnCl_2 + 2KCl + 5Cl_2 + 8H_2O$ all 6 formulae on correct sides of arrow (2) 4 or 5 formulae on correct sides of arrow (1) balancing of correct formulae only (1)	allow multiples do not penalise incorrect cases, subscripts e.g allow CL^2 ignore state symbols	**(3)** **AO2-1**

Question number	Answer	Mark
5(a)	**D** 82% is the only correct answer **A** is not correct as this is percentage of hydrogen in ammonia **B** is not correct as this is the mass of hydrogen multiplied by the mass of nitrogen **C** is not correct as this is the mass of hydrogen multiplied by the mass of ammonia	**(1)** **AO2-1**

Question number	Answer	Mark
5(b)(i)	**C** arrow R is the only correct answer **A, B** and **D** are incorrect because they do not show the activation energy	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	A description to include: any two for 1 mark all three for 2 marks • energy is taken in breaking bonds (in the reactants) • energy is given out making bonds (in the products) • more energy is given out than taken in	 allow breaking bonds is endothermic allow forming bonds is exothermic allow less energy taken in than given out ignore products have less energy than reactants ignore reaction is exothermic / gives out energy alone for energy taken in allow : absorbed / needed / used /required for energy given out allow: released	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	-76 with or without working scores 4 BROKEN 944 + (3 x 436) = 2252 (1) MADE 2 x (3x388) = 2328 (1) DIFFERENCE (broken) 2252 – (made) 2328 (1) ANSWER = - 76 (1)	allow ecf ignore sign ignore sign MP3 for difference between their 2 values MP4 for correct evaluation, including correct sign, of <u>bonds broken – bonds made</u> using their values (+)76 scores 3 (+)1088 scores 3 (+)604 scores 3 (+)1476 scores 3 -1088 scores 2 -604 scores 2	**(4)** **AO2-1**

Question number	Answer	Additional guidance	Mark
5(c)	an explanation linking AMMONIA ammonia {is simple molecular / has weak intermolecular forces} SILICON DIOXIDE silicon dioxide is {giant **covalent** / has strong **covalent** bonds} (1) DIFFERENCE more {**heat / energy**} to break bonds in silicon dioxide than intermolecular forces in ammonia	Mark independently allow weak {forces / bonds} <u>between molecules</u> allow <u>intermolecular</u> bonds reject anything ionic for MP1 allow macromolecular reject anything ionic / simple molecular for MP2 in MP3 mark is for saying **more** energy/ heat needed to break the 'attractions' <u>in silicon dioxide</u> **than** <u>in ammonia</u>. The 'attractions' do not have to be correct. allow the **energy** required to break the attractions in ammonia is small **and** the energy required to break the attractions in silicon dioxide is large	**(3)** **AO1-1**

Question number	Answer	Mark
6(a)(i)	**C** surfacing roads fuel for trains fuel for large ships is the only correct answer **A** and **B** are incorrect as bitumen is not used as a fuel for large ships **D** is not correct as diesel oil is not used for fuel for large ships	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(a)(ii)	An explanation linking • (viscosity increases down the column) as molecules are {larger/ longer/ more carbons} (1) • because there are stronger {intermolecular forces / forces **between** molecules} (1)	allow ORA allow stronger **intermolecular** bonds/ forces of attraction/ (surface area of) contact allow more **intermolecular** forces	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(b)	M_r of CH_2 = 12 + (2x1) = 14 (1) $\frac{56}{14}$ = 4 (1) formula of Y = 4 x CH_2 = C_4H_8 (1) formula of X = (C_6H_{14} + C_4H_8 =) $C_{10}H_{22}$ (1)	allow ecf throughout MP1 must be for CH_2 allow 14 x 4 = 56 allow Y has 4C and 8H C_4H_8 without working scores MP3 only. C_4H_8 = (4 x 12) + (8 x 1) = 56 scores MP1, 2 and 3 for MP4 must be written as formula $C_{10}H_{22}$ without working scores MP4 only ecf can be awarded for MP4 as long as working for alkene to be added is seen ignore formula of X = (C_6H_{14} + CH_2 =) C_7H_{16}	**(4)** **AO3-1**

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 outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) and AO2 (3 marks)** Ignore any issues with methane itself e.g. it is a greenhouse gas. Ignore different colours of flame with open/ closed air hole. OPEN AIR-HOLE • air-hole open, allows lots of oxygen to mix with methane • therefore complete combustion takes place • $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$ • carbon dioxide and water are produced. CLOSED AIR-HOLE • air-hole closed, less oxygen can enter to mix with methane • therefore incomplete combustion takes place • e.g $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$ (allow other correct examples) • carbon monoxide can be produce HARMFUL EFFECTS • CO is odourless and colourless • carbon monoxide combines with haemoglobin in place of oxygen/ reduces capacity of blood for oxygen • therefore toxic • carbon/ soot can also be produced • can aggravate asthma / respiratory problems • soot makes buildings dirty • carbon dioxide and water are greenhouse gases • absorb heat energy radiated from Earth which is re-radiated back into the atmosphere • increases greenhouse effect • causes global warming/ climate change • melt polar ice caps / sea levels rise	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1 A description of open or closed air -hole or description of one harmful effect	1–2	closed air-hole gives less oxygen (1) closed air-hole gives less oxygen, open air-hole gives more oxygen (1) closed air-hole gives incomplete combustion (1) closed air-hole has less oxygen so incomplete combustion (2) complete combustion gives carbon dioxide (1) when the air-hole is open, oxygen allows complete combustion gives carbon dioxide and water (2)
Level 2 Description of two of: open air-hole/ closed air hole/ harmful effect	3–4	A closed air-hole gives less oxygen which produces soot and carbon monoxide which is toxic because it bonds to haemoglobin. (3) More oxygen gives carbon dioxide and water and incomplete combustion gives carbon monoxide and water. (4) Complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, this causes global temperatures to rise and leads to an increase in polar ice caps melting. (4)
Level 3 All **three aspects must be covered** Description of all three of: open air-hole/ closed air-hole/ harmful effect(s)	5–6	Incomplete combustion makes carbon monoxide but complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, this causes global temperatures to rise and leads to an increase in polar ice caps melting. (5) A closed air-hole gives incomplete combustion which produces carbon monoxide which is an odourless and colourless toxic gas. Complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, increases the greenhouse effect and temperature of the Earth’s atmosphere. (6)

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • 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	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • 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	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • 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)