



# Mark Scheme (Results)

Summer 2021

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1C and Science  
(Double Award) (4SD0) Paper 1C

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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.

Question number	Answer	Notes	Marks												
1 (a)	<table border="1"> <thead> <tr> <th data-bbox="400 286 778 349">Information</th> <th data-bbox="783 286 1010 349">Substance</th> </tr> </thead> <tbody> <tr> <td data-bbox="400 356 778 450">a good conductor of electricity</td> <td data-bbox="783 356 1010 450">copper</td> </tr> <tr> <td data-bbox="400 456 778 551">an element that has a basic oxide</td> <td data-bbox="783 456 1010 551">copper</td> </tr> <tr> <td data-bbox="400 557 778 651">a substance used as a fuel</td> <td data-bbox="783 557 1010 651">methane</td> </tr> <tr> <td data-bbox="400 658 778 752">a major cause of acid rain</td> <td data-bbox="783 658 1010 752">sulfur dioxide</td> </tr> <tr> <td data-bbox="400 759 778 875">a non-metallic element that is a solid at room temperature</td> <td data-bbox="783 759 1010 875">iodine</td> </tr> </tbody> </table>	Information	Substance	a good conductor of electricity	copper	an element that has a basic oxide	copper	a substance used as a fuel	methane	a major cause of acid rain	sulfur dioxide	a non-metallic element that is a solid at room temperature	iodine	ALLOW correct formulae	5
Information	Substance														
a good conductor of electricity	copper														
an element that has a basic oxide	copper														
a substance used as a fuel	methane														
a major cause of acid rain	sulfur dioxide														
a non-metallic element that is a solid at room temperature	iodine														
(b)	<p>A description which refers to the following points</p> <p><b>M1</b> bubble/add (the gas/carbon dioxide) into limewater</p> <p><b>M2</b> (limewater) turns cloudy/milky</p>	<p><b>ACCEPT</b> calcium hydroxide</p> <p><b>ACCEPT</b> white precipitate</p> <p><b>M2</b> dep on use of limewater/calcium hydroxide in <b>M1</b></p>	2												
			<b>Total 7</b>												

Question number	Answer	Notes	Marks												
2 (a) (i)	<table border="1" data-bbox="383 340 957 734"> <thead> <tr> <th data-bbox="383 340 596 510">Sub-atomic particle</th> <th data-bbox="603 340 778 510">Relative mass</th> <th data-bbox="785 340 957 510">Relative charge</th> </tr> </thead> <tbody> <tr> <td data-bbox="383 519 596 586">electron</td> <td data-bbox="603 519 778 586">0.0005</td> <td data-bbox="785 519 957 586">-1</td> </tr> <tr> <td data-bbox="383 595 596 663">proton</td> <td data-bbox="603 595 778 663">1</td> <td data-bbox="785 595 957 663">+1</td> </tr> <tr> <td data-bbox="383 672 596 734">neutron</td> <td data-bbox="603 672 778 734">1</td> <td data-bbox="785 672 957 734">0</td> </tr> </tbody> </table>	Sub-atomic particle	Relative mass	Relative charge	electron	0.0005	-1	proton	1	+1	neutron	1	0	<p>1 mark for each correct answer</p> <p>ACCEPT minus one REJECT - unqualified</p> <p>ACCEPT one ALLOW +1</p> <p>ACCEPT zero/none/ no charge</p>	3
Sub-atomic particle	Relative mass	Relative charge													
electron	0.0005	-1													
proton	1	+1													
neutron	1	0													
(ii)	nucleus		1												
(b) (i)	U		1												
(ii)	25		1												
(iii)	W		1												
(iv)	Y and Z		1												

Question number	Answer	Notes	Marks
2 (c)	<ul style="list-style-type: none"> <li>• sum of masses multiplied by percentages</li> <li>• division by 100</li> <li>• answer given to 1 decimal place</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>(91.2 \times 20) + (8.80 \times 22)</math> <b>OR</b> 2017.6</p> <p><b>M2</b> <math>2017.6 \div 100</math> <b>OR</b> 20.176</p> <p><b>M3</b> 20.2 <b>OR</b> answer from <b>M2</b> given to 1d.p.</p>	<p>Correct answer of 20.2 with or without working scores 3</p> <p><b>ACCEPT</b> 2018</p> <p><b>ACCEPT</b> 20.18</p> <p>correct answer without working scores 3</p> <p>20.176 and 20.18 without working score 2</p> <p>2020 scores <b>M1</b> and <b>M3</b></p> <p>20 without working scores 0</p> <p>20 with correct working scores 2</p>	<p>3</p> <p><b>Total 11</b></p>

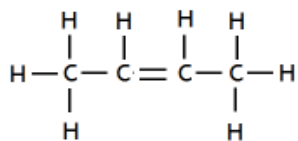
Question number	Answer	Notes	Marks
3 (a) (i)	diffusion		1
(ii)	Any two from <b>M1</b> stir (the mixture) <b>M2</b> heat (the mixture) <b>M3</b> grind the sugar or break into smaller pieces or increase its surface area	<b>ALLOW</b> shake/swirl  <b>ALLOW</b> any description of heating	2
(b) (i)	(simple) distillation	<b>REJECT</b> fractional distillation <b>ALLOW</b> distilling OWTTE	1
(ii)	An explanation that links the following two points <b>M1</b> (water/ vapour/ steam / gas) is cooled <b>M2</b> and condenses <b>OR</b> in the condenser		2
			<b>Total 6</b>

Question number	Answer	Notes	Marks
4 (a) (i)	<p>A description including any three of the following</p> <p><b>M1</b> pour some solvent into a beaker /chromatography tank</p> <p><b>M2</b> place the paper in the solvent so that the food colourings are above the level of the solvent</p> <p><b>M3</b> leave the paper until the solvent reaches the level shown in the diagram/ has moved to near the top of the paper OWTTE</p> <p><b>M4</b> take the paper out and leave to dry</p>	<p><b>M1</b> and <b>M2</b> can be scored from a labelled diagram</p> <p><b>ALLOW</b> any named solvent</p>	3
(ii)	one/1		1
(iii)	(F/it is) insoluble (in the solvent)/ does not dissolve (in the solvent)		1
(iv)	<p><b>M1</b> E and H</p> <p><b>M2</b> they contain a dye that moved the furthest (distance up the paper)/ is closest to the solvent front / has the greatest <math>R_f</math> value</p>	<b>M2</b> dep on <b>M1</b>	2
(b)	<p><b>M1</b> distance moved by solvent = 59-61mm and distance moved by the dye = 37-41mm</p> <p><b>M2</b> distance moved by the dye <math>\div</math> distance moved by the solvent <math>\approx</math> 0.67</p> <p><b>M3</b> (the dye in food colouring) G</p>	<p><b>ALLOW</b> distances in cm e.g. 6cm and 4cm</p> <p>If paper has been printed on A4 distances will be 51-53mm and 33-37mm</p> <p><b>ALLOW</b> alternative methods</p>	3
			<b>Total 10</b>

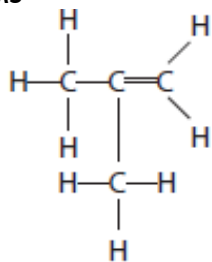


Question number	Answer	Notes	Marks								
5 (a) (i)	<table border="1"> <tr> <td>molecular formula</td> <td>C<sub>2</sub>H<sub>6</sub></td> </tr> <tr> <td>name</td> <td>ethane</td> </tr> <tr> <td>empirical formula</td> <td>CH<sub>3</sub></td> </tr> <tr> <td>displayed formula</td> <td> <pre>       H   H             H - C - C - H                   H   H           </pre> </td> </tr> </table>	molecular formula	C <sub>2</sub> H <sub>6</sub>	name	ethane	empirical formula	CH <sub>3</sub>	displayed formula	<pre>       H   H             H - C - C - H                   H   H           </pre>	Penalise incorrect use of case, superscripts	3
molecular formula	C <sub>2</sub> H <sub>6</sub>										
name	ethane										
empirical formula	CH <sub>3</sub>										
displayed formula	<pre>       H   H             H - C - C - H                   H   H           </pre>										
(ii)	$2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$	ACCEPT multiples and fractions	1								
(iii)	Any two from M1 carbon monoxide/CO M2 carbon/C M3 water (vapour)/steam/H <sub>2</sub> O	ALLOW soot IGNORE carbon dioxide	2								
(b) (i)	A addition B is incorrect as it is not a decomposition reaction C is incorrect as no solid precipitate is produced D is incorrect as it is not a substitution reaction		1								
(ii)	Any two from M1 <pre>       H   H   H   H                     H - C = C - C - C - H                           H   H           </pre>	Do not accept displayed formulae of cyclic alkanes	2								

M2



M3



(iii) isomers

**ALLOW** cis-trans (E/Z)  
isomers of but-2-ene for  
both marks

**ALLOW** isomerism

1

Question number	Answer	Notes	Marks
5 (c) (i)	$\left[ \begin{array}{cc} \text{H} & \text{CH}_3 \\   &   \\ -\text{C} & -\text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$ <p><b>M1</b> correct repeat unit</p> <p><b>M2</b> extension bonds, brackets and n after brackets</p>	If double bond between carbon atoms scores 0	2
(ii)	<p>A discussion which refers to the following points</p> <p><b>M1</b> polymers/poly(propene) will remain in landfill indefinitely OWTTE</p> <p><b>M2</b> (as they) are inert /unreactive/do not biodegrade</p> <p><b>M3</b> burning produces toxic gases</p>	<b>ALLOW</b> burning produces greenhouse gases	3
<b>Total 15</b>			

Question number	Answer	Notes	Marks
6 (a) (i)	Any 3 from <b>M1</b> effervescence/bubbles/fizzing <b>M2</b> moves <b>M3</b> floats <b>M4</b> disappears/gets smaller <b>M5</b> vapour trail/steam	moves on surface scores <b>M2</b> and <b>M3</b>  <b>ALLOW</b> dissolves  <b>IGNORE</b> melts/heat produced <b>IGNORE</b> any reference to indicators	3
(ii)	An explanation that links the following two points  <b>M1</b> the universal indicator turns purple/blue <b>M2</b> (because) OH <sup>-</sup> /hydroxide ions are present	<b>ALLOW</b> an alkaline solution /an alkali is produced / a solution of high pH is formed	2
(iii)	$2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$  <b>M1</b> all formulae correct <b>M2</b> balancing of correct formulae	<b>ALLOW</b> multiples and fractions  <b>M2</b> dep on <b>M1</b>	2
(b) (i)	An explanation that links the following two points  <b>M1</b> to remove any other ions/chemicals/ impurities/ contaminants/ compounds/substances (that may be on the wire)  <b>M2</b> (so that) they do not interfere with/mask the colour of the flame	<b>ALLOW</b> (so that) they do not affect the result (of the test) <b>ALLOW</b> (remove substances) that could colour the flame	2

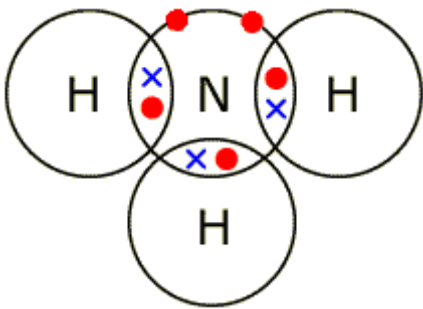
(ii)	<b>D yellow</b> A is incorrect as sodium ions do not give a green flame B is incorrect as sodium ions do not give a lilac flame C is incorrect as sodium ions do not give a red flame		1
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Question number	Answer	Notes	Marks
6 (c) (i)	$K^+$ and $SO_4^{2-}$		1
(ii)	<p>An explanation that links the following four points</p> <p><b>M1</b> (potassium sulfate) has a giant (ionic) structure /lattice</p> <p><b>M2</b> electrostatic attraction between oppositely charged ions</p> <p><b>M3</b> (ionic bonds or forces / attractions between ions) are strong</p> <p><b>M4</b> a large amount of energy is needed to overcome the forces/break the bonds</p>	ionic bonds are strong scores M3	4
			<b>Total 15</b>

Question number	Answer	Notes	Marks						
7 (a) (i)	→ magnesium chloride + hydrogen	ACCEPT in either order	1						
(b) (i)	<table border="1" data-bbox="438 622 1011 880"> <tbody> <tr> <td data-bbox="438 622 858 719">temperature of the acid at the start in °C</td> <td data-bbox="858 622 1011 719">22.4</td> </tr> <tr> <td data-bbox="438 719 858 815">highest temperature reached in °C</td> <td data-bbox="858 719 1011 815">43.2</td> </tr> <tr> <td data-bbox="438 815 858 880">temperature rise in °C</td> <td data-bbox="858 815 1011 880">20.8</td> </tr> </tbody> </table>	temperature of the acid at the start in °C	22.4	highest temperature reached in °C	43.2	temperature rise in °C	20.8	ALLOW ECF from incorrect starting temperature	2
temperature of the acid at the start in °C	22.4								
highest temperature reached in °C	43.2								
temperature rise in °C	20.8								

Question number	Answer	Notes	Marks
7 (ii)	<ul style="list-style-type: none"> <li>substitute correct values into <math>Q = mc\Delta T</math></li> <li>evaluation</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>Q = 25 \times 4.2 \times 20.8</math></p> <p><b>M2</b> 2184 (J)</p>	<p>Correct answer of 2184 or 2194 without working scores 2</p> <p><b>ALLOW</b> 25.12g for m</p> <p><b>ACCEPT</b> any number of sig figs except 1</p> <p><b>ALLOW</b> ECF from M1</p>	2
	<p>(iii)</p> <ul style="list-style-type: none"> <li>find the amount of magnesium in moles</li> <li>divide <math>Q</math> by <math>n</math></li> <li>convert answer in J/mol to kJ/mol</li> <li>answer including sign</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>n(\text{Mg}) = 0.12 \div 24</math> <b>OR</b> 0.005(0)</p> <p><b>M2</b> <math>Q \div n</math> <b>OR</b> <math>2184 \div 0.005(0)</math> <b>OR</b> 436,800 (J/mol)</p> <p><b>M3</b> <math>436,800 \div 1000</math> <b>OR</b> 436.8 (kJ/mol)</p> <p><b>M4</b> – 436.8 (kJ/mol)</p>	<p><b>ACCEPT</b> use of 2180 or 2200</p> <p><b>ALLOW</b> ECF on incorrect answer to (ii) and/or <b>M1</b></p> <p><b>ALLOW</b> ECF on incorrect answer to <b>M2</b></p> <p><b>ALLOW</b> ECF on incorrect answer to <b>M3</b></p> <p>Correct answer with minus sign and without working scores 4</p> <p>Correct answer without minus sign and without working scores 3</p> <p><b>ACCEPT</b> any number of sig figs except 1 throughout (ii)</p> <p>-438.8 or -438.9 also scores 4 (from 5.12g and 2194J in (ii))</p>	4
			<b>Total 9</b>



Question number	Answer	Notes	Marks
8 (a)	<p>A description which refers to the following six points</p> <p>Test for ammonium ions:</p> <p><b>M1</b> add sodium hydroxide (solution) (and warm)</p> <p><b>M2</b> test the gas with (damp) (red) litmus paper / (damp) universal indicator paper</p> <p><b>M3</b> (litmus) turns blue / (universal indicator) turns blue/purple (if ammonium ions are present)</p> <p>Test for sulfate ions:</p> <p><b>M4</b> add (dilute hydrochloric/nitric) acid</p> <p><b>M5</b> add barium chloride (solution) / barium nitrate (solution)</p> <p><b>M6</b> white precipitate (if sulfate ions are present)</p>	<p><b>ALLOW</b> other alkalis</p> <p>No <b>M2</b> or <b>M3</b> if solution tested with litmus/ universal indicator paper</p> <p><b>M4</b> and <b>M5</b> can be in either order</p> <p>No <b>M4</b> or <b>M6</b> if sulfuric acid added <b>M6</b> dep on <b>M5</b></p>	6
(b) (i)	neutralisation	<b>ALLOW</b> acid-base OR acid-alkali	1
(ii)	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$	<b>ALLOW</b> multiples	1
(iii)	<p><b>M1</b> 3 bonding pairs correct</p> <p><b>M2</b> rest of molecule correct</p> 	<p><b>M2</b> dep on <b>M1</b></p> <p><b>ALLOW</b> any combination of dots and crosses</p>	2
<b>Total 10</b>			

Question number	Answer	Notes	Marks
9 (a) (i)	carbon dioxide/a gas is given off/escapes	<b>REJECT</b> incorrect gas	1
(ii)	to prevent acid/ liquid/ solution/ spray from leaving the flask OWTTE		1
(iii)	An explanation that links two of the following <b>M1</b> (insoluble) calcium sulfate will form <b>M2</b> which will form a coating/ layer on the marble chips <b>M3</b> slowing down/ preventing/ stopping the reaction	<b>M3</b> dep on M1 or M2	2
(b) (i)	An explanation that links the following four points <b>M1</b> the curve is steep(est) at the start <b>M2</b> because the (acid) concentration is high(est) <b>M3</b> the curve becomes less steep as the solution/ acid is becoming more dilute <b>M4</b> the curve levels off/ stops going up when the acid has all been used up  <b>OR</b> <b>M1</b> the curve is steep(est) at the start <b>M2</b> because the reaction is fast(est) at the start <b>M3</b> the curve becomes less steep because the reaction slows down <b>M4</b> the curve levels off/stops going up when the acid has all been used up	<b>ALLOW</b> there are the most (acid) particles in solution  <b>ALLOW</b> the curve becomes less steep as there are fewer acid particles/particles in solution  <b>IGNORE</b> references to particles of marble chips <b>IGNORE</b> references to energy	4

(ii)	M1 curve drawn starting at the origin and below the original curve M2 curve levels off at 0.27 g + or - half a small square		2
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Question number	Answer	Notes	Marks
9 (c)	<p>An explanation that links the following four points</p> <p><b>M1</b> the rate of reaction increases/ the reaction is faster/ the reaction speeds up</p> <p>and any three from</p> <p><b>M2</b> because the particles gain (kinetic) energy /move faster</p> <p><b>M3</b> there are more collisions per unit time</p> <p><b>M4</b> more collisions/particles have energy greater than the activation energy</p> <p><b>M5</b> more collisions are successful</p>	<p>there are more frequent successful collisions scores <b>M3</b> and <b>M5</b></p>	<p>4</p> <p><b>Total 14</b></p>

Question number	Answer	Notes	Marks
10 (a)	(i) so that the (hot) lead does not react with oxygen/air (converting back into lead oxide)	<b>ACCEPT</b> so that lead is not oxidised (back to lead oxide)	1
	(ii) M1 repeat the heating M2 until the mass remains constant/ does not change	<b>ACCEPT</b> heat to constant mass for both marks	2
(b)	(i) 4.66 (g)		1
	(ii) 0.48 (g)		1
	(iii) <ul style="list-style-type: none"> <li>calculate the moles of lead and oxygen</li> <li>divide by the smaller number</li> <li>calculate the whole number ratio</li> <li>give the empirical formula</li> </ul> <p>Example calculation</p> <p>M1 <math>\frac{4.66}{207}</math> and <math>\frac{0.48}{16}</math> OR 0.0225 and 0.03(00)</p> <p>M2 <math>\frac{0.0225}{0.0225}</math> and <math>\frac{0.03(00)}{0.0225}</math> OR 1:1.33</p> <p>M3 1 x 3 and 1.33 x 3 OR 3:4</p> <p>M4 Pb<sub>3</sub>O<sub>4</sub></p>	<p>Division by atomic numbers or upside down calculation scores 0</p> <p>3:4 ratio without working scores 3</p> <p>Pb<sub>3</sub>O<sub>4</sub> without working scores 4</p> <p><b>ALLOW</b> ECF from incorrect masses.</p>	4

Question number	Answer	Notes	Marks
10 (c) (i)	$\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2\text{HCl} (\text{aq}) \rightarrow \text{PbCl}_2 (\text{s}) + 2\text{HNO}_3 (\text{aq})$	<b>ALLOW</b> any combination of uppercase and lowercase letters	1
	<p>(ii)</p> <ul style="list-style-type: none"> <li>• calculate the amount of <math>\text{PbCl}_2</math></li> <li>• multiply the moles by the <math>M_r</math> of <math>\text{PbCl}_2</math></li> <li>• evaluation to show that the value is about 5 g</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>n(\text{PbCl}_2) = \frac{0.0370}{2}</math> <b>OR</b> 0.0185 (mol)</p> <p><b>M2</b> mass of <math>\text{PbCl}_2 = 0.0185 \times 278</math> (g)</p> <p><b>M3</b> 5.143 (g)</p>	<p><b>MAX 1</b> for <math>0.0370 \times 278</math> if no division by 2 in <b>M1</b></p> <p><b>ALLOW</b> any number of sig figs</p> <p>5.1, 5.14 and 5.143 g without working score 3</p> <p>5 g without working scores 0</p> <p><b>ALLOW</b> alternative methods</p>	3
			<b>Total 13</b>

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