



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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Summer 2021

Question Paper Log Number 66056

Publications Code 4SD0_1C_2106_MS

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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>M1 bubble/add (the gas/carbon dioxide) into limewater</p> <p>M2 (limewater) turns cloudy/milky</p>	<p>ACCEPT calcium hydroxide</p> <p>ACCEPT white precipitate</p> <p>M2 dep on use of limewater/calcium hydroxide in M1</p>	2												
			Total 7												

Question number	Answer	Notes	Marks												
2 (a) (i)	<table border="1"> <thead> <tr> <th>Sub-atomic particle</th> <th>Relative mass</th> <th>Relative charge</th> </tr> </thead> <tbody> <tr> <td>electron</td> <td>0.0005</td> <td>-1</td> </tr> <tr> <td>proton</td> <td>1</td> <td>+1</td> </tr> <tr> <td>neutron</td> <td>1</td> <td>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												

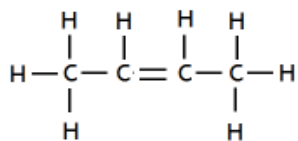
Question number	Answer	Notes	Marks
2 (c)	<ul style="list-style-type: none"> • sum of masses multiplied by percentages • division by 100 • answer given to 1 decimal place <p>Example calculation</p> <p>M1 $(91.2 \times 20) + (8.80 \times 22)$ OR 2017.6</p> <p>M2 $2017.6 \div 100$ OR 20.176</p> <p>M3 20.2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

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

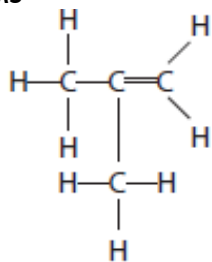
Question number	Answer	Notes	Marks
4 (a) (i)	<p>A description including any three of the following</p> <p>M1 pour some solvent into a beaker /chromatography tank</p> <p>M2 place the paper in the solvent so that the food colourings are above the level of the solvent</p> <p>M3 leave the paper until the solvent reaches the level shown in the diagram/ has moved to near the top of the paper OWTTE</p> <p>M4 take the paper out and leave to dry</p>	<p>M1 and M2 can be scored from a labelled diagram</p> <p>ALLOW 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>M1 E and H</p> <p>M2 they contain a dye that moved the furthest (distance up the paper)/ is closest to the solvent front / has the greatest R_f value</p>	M2 dep on M1	2
(b)	<p>M1 distance moved by solvent = 59-61mm and distance moved by the dye = 37-41mm</p> <p>M2 distance moved by the dye \div distance moved by the solvent \approx 0.67</p> <p>M3 (the dye in food colouring) G</p>	<p>ALLOW 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>ALLOW alternative methods</p>	3
			Total 10

Question number	Answer	Notes	Marks								
5 (a) (i)	<table border="1" style="width: 100%;"> <tr> <td>molecular formula</td> <td>C_2H_6</td> </tr> <tr> <td>name</td> <td>ethane</td> </tr> <tr> <td>empirical formula</td> <td>CH_3</td> </tr> <tr> <td>displayed formula</td> <td> <pre> H H H - C - C - H H H </pre> </td> </tr> </table>	molecular formula	C_2H_6	name	ethane	empirical formula	CH_3	displayed formula	<pre> H H H - C - C - H H H </pre>	Penalise incorrect use of case, superscripts	3
	molecular formula	C_2H_6									
	name	ethane									
empirical formula	CH_3										
displayed formula	<pre> H H H - C - C - H H H </pre>										
(ii) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$	ACCEPT multiples and fractions	1									
(iii) Any two from M1 carbon monoxide/CO M2 carbon/C M3 water (vapour)/steam/ H_2O	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>M1 correct repeat unit</p> <p>M2 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>M1 polymers/poly(propene) will remain in landfill indefinitely OWTTE</p> <p>M2 (as they) are inert /unreactive/do not biodegrade</p> <p>M3 burning produces toxic gases</p>	ALLOW burning produces greenhouse gases	3
			Total 15

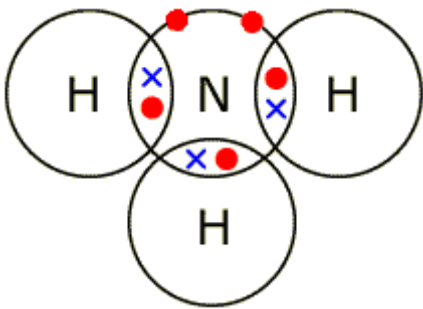
Question number	Answer	Notes	Marks
6 (a) (i)	<p>Any 3 from</p> <p>M1 effervescence/bubbles/fizzing</p> <p>M2 moves</p> <p>M3 floats</p> <p>M4 disappears/gets smaller</p> <p>M5 vapour trail/steam</p>	<p>moves on surface scores M2 and M3</p> <p>ALLOW dissolves</p> <p>IGNORE melts/heat produced</p> <p>IGNORE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

(ii)	D yellow 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>M1 (potassium sulfate) has a giant (ionic) structure /lattice</p> <p>M2 electrostatic attraction between oppositely charged ions</p> <p>M3 (ionic bonds or forces / attractions between ions) are strong</p> <p>M4 a large amount of energy is needed to overcome the forces/break the bonds</p>	ionic bonds are strong scores M3	4
			Total 15

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 1013 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 1013 719">22.4</td> </tr> <tr> <td data-bbox="438 719 858 815">highest temperature reached in °C</td> <td data-bbox="858 719 1013 815">43.2</td> </tr> <tr> <td data-bbox="438 815 858 880">temperature rise in °C</td> <td data-bbox="858 815 1013 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"> substitute correct values into $Q = mc\Delta T$ evaluation <p>Example calculation</p> <p>M1 $Q = 25 \times 4.2 \times 20.8$</p> <p>M2 2184 (J)</p>	<p>Correct answer of 2184 or 2194 without working scores 2</p> <p>ALLOW 25.12g for m</p> <p>ACCEPT any number of sig figs except 1</p> <p>ALLOW ECF from M1</p>	2
(iii)	<ul style="list-style-type: none"> find the amount of magnesium in moles divide Q by n convert answer in J/mol to kJ/mol answer including sign <p>Example calculation</p> <p>M1 $n(\text{Mg}) = 0.12 \div 24$ OR 0.005(0)</p> <p>M2 $Q \div n$ OR $2184 \div 0.005(0)$ OR 436,800 (J/mol)</p> <p>M3 $436,800 \div 1000$ OR 436.8 (kJ/mol)</p> <p>M4 – 436.8 (kJ/mol)</p>	<p>ACCEPT use of 2180 or 2200</p> <p>ALLOW ECF on incorrect answer to (ii) and/or M1</p> <p>ALLOW ECF on incorrect answer to M2</p> <p>ALLOW ECF on incorrect answer to M3</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>ACCEPT 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
			Total 9

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

Question number	Answer	Notes	Marks
9 (a) (i)	carbon dioxide/a gas is given off/escapes	REJECT 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 M1 (insoluble) calcium sulfate will form M2 which will form a coating/ layer on the marble chips M3 slowing down/ preventing/ stopping the reaction	M3 dep on M1 or M2	2
(b) (i)	An explanation that links the following four points M1 the curve is steep(est) at the start M2 because the (acid) concentration is high(est) M3 the curve becomes less steep as the solution/ acid is becoming more dilute M4 the curve levels off/ stops going up when the acid has all been used up OR M1 the curve is steep(est) at the start M2 because the reaction is fast(est) at the start M3 the curve becomes less steep because the reaction slows down M4 the curve levels off/stops going up when the acid has all been used up	ALLOW there are the most (acid) particles in solution ALLOW the curve becomes less steep as there are fewer acid particles/particles in solution IGNORE references to particles of marble chips IGNORE 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>M1 the rate of reaction increases/ the reaction is faster/ the reaction speeds up</p> <p>and any three from</p> <p>M2 because the particles gain (kinetic) energy /move faster</p> <p>M3 there are more collisions per unit time</p> <p>M4 more collisions/particles have energy greater than the activation energy</p> <p>M5 more collisions are successful</p>	<p>there are more frequent successful collisions scores M3 and M5</p>	<p>4</p> <p>Total 14</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)	ACCEPT 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	ACCEPT 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"> calculate the moles of lead and oxygen divide by the smaller number calculate the whole number ratio give the empirical formula <p>Example calculation</p> <p>M1 $\frac{4.66}{207}$ and $\frac{0.48}{16}$ OR 0.0225 and 0.03(00)</p> <p>M2 $\frac{0.0225}{0.0225}$ and $\frac{0.03(00)}{0.0225}$ OR 1:1.33</p> <p>M3 1 x 3 and 1.33 x 3 OR 3:4</p> <p>M4 Pb₃O₄</p>	<p>Division by atomic numbers or upside down calculation scores 0</p> <p>3:4 ratio without working scores 3</p> <p>Pb₃O₄ without working scores 4</p> <p>ALLOW ECF from incorrect masses.</p>	4

Question number	Answer	Notes	Marks
10 (c) (i)	$\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2\text{HCl} (\text{aq}) \rightarrow \text{PbCl}_2 (\text{s}) + 2\text{HNO}_3 (\text{aq})$	ALLOW any combination of uppercase and lowercase letters	1
	<p>(ii)</p> <ul style="list-style-type: none"> • calculate the amount of PbCl_2 • multiply the moles by the M_r of PbCl_2 • evaluation to show that the value is about 5 g <p>Example calculation</p> <p>M1 $n(\text{PbCl}_2) = \frac{0.0370}{2}$ OR 0.0185 (mol)</p> <p>M2 mass of $\text{PbCl}_2 = 0.0185 \times 278$ (g)</p> <p>M3 5.143 (g)</p>	<p>MAX 1 for 0.0370×278 if no division by 2 in M1</p> <p>ALLOW 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>ALLOW alternative methods</p>	3
			Total 13

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