



# Mark Scheme (Results)

November 2020

Pearson Edexcel International GCSE  
In Chemistry (4CH1) Paper 1C and Science  
(Double Award) (4SD0) Paper 1C

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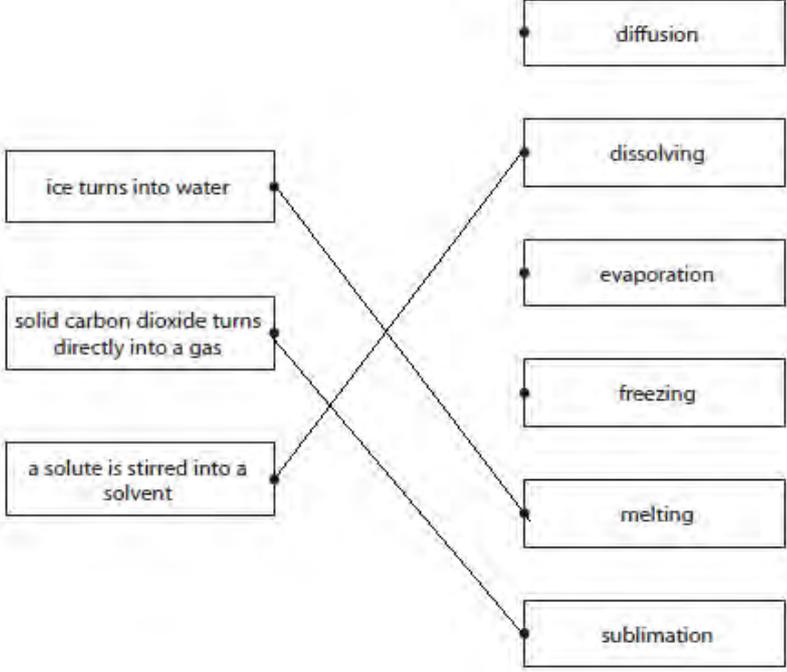
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## General Marking Guidance

- 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) (i)	Boron/B		1 cler
(ii)	Na/Mg/Al		1 cler
(iii)	Silicon/Si		1 cler
(iv)	Nitrogen/N	ALLOW N <sub>2</sub>	1 cler
(v)	aluminium oxide	ALLOW Al <sub>2</sub> O <sub>3</sub>	1 cler
(b) (i)	<p><b>D</b> Group 0 is correct because Group 0 contains elements that are all unreactive</p> <p><b>A</b> is not correct because Group 2 does not contain elements that are all unreactive</p> <p><b>B</b> is not correct because Group 5 does not contain elements that are all unreactive</p> <p><b>C</b> is not correct because Group 6 does not contain elements that are all unreactive</p>		1 comp
(ii)	<p><b>B</b> lithium is correct because lithium is the least reactive element in Group 1</p> <p><b>A</b> is not correct because caesium is not the least reactive element in Group 1</p> <p><b>C</b> is not correct because potassium is not the least reactive element in Group 1</p> <p><b>D</b> is not correct because sodium is not the least reactive element in Group 1</p>		1 comp

Total for Q1 = 7 marks

Question number	Answer	Notes	Marks
2 (a)		<p>1 mark for each correct line form boxes on left</p> <p>If more than one line from a box on left column do not award mark for that box</p>	3 cler
(b)	<p>a description including</p> <p>M1 measure the melting point</p> <p>M2 if fixed/sharp melting point the substance is pure</p> <p>M3 if melts over range of temperatures the substance is a mixture</p>	<p>ALLOW measure boiling point for M1 and substitute b.p. for m.p in M2 and boils for melts in M3</p> <p>ALLOW max 2 if reference to freezing point as opposed to melting point</p>	3 grad

Total for Q2 = 6 marks

Question number	Answer	Notes	Marks
3 (a) (i)	Q		1 cler
(ii)	might be explosive/dangerous/unsafe		1 grad
(iii)	R S P Q		1 cler
(b) (i)	galvanising/galvanisation		1 grad
(ii)	Any one from paint/oil/grease/sacrificial protection OWTTE	IGNORE barrier method  If answer to (i) missing or incorrect credit galvanising in (ii)	1 grad
(c) (i)	zinc displaces copper	ALLOW zinc replaces copper/zinc takes oxygen from copper	1 grad
(ii)	M1 copper(II) oxide/CuO M2 because copper(II) oxide/CuO/it loses oxygen	ALLOW because copper(II) oxide/CuO/it gives oxygen to zinc/is reduced  M2 DEP M1 or near miss e.g. Cu as it gives oxygen to zinc scores 1 mark for M2  IGNORE references to electrons	2 expert

Total for Q3 = 8 marks

Question number	Answer	Notes	Marks
4 (a) (i)	hydroxide/OH <sup>-</sup>	ALLOW HO <sup>-</sup> REJECT OH	1 grad
(ii)	<p><b>C</b> 11 is correct because 11 is a possible pH for ammonia solution</p> <p><b>A</b> is not correct because 3 is not a possible pH for ammonia solution</p> <p><b>B</b> is not correct because 6 is not a possible pH for ammonia solution</p> <p><b>D</b> is not correct because 14 is not a possible pH for ammonia solution</p>		1 comp
(b) (i)	<p><b>C</b> a proton donor is correct because an acid acts as a proton donor</p> <p><b>A</b> is not correct because an acid does not act as a neutron donor</p> <p><b>B</b> is not correct because an acid does not act as a neutron acceptor</p> <p><b>D</b> is not correct because an acid does not act as a proton acceptor</p>		1 comp
(ii)	<p><b>C</b> is correct because phenolphthalein is pink in alkali and colourless in acid</p> <p><b>A</b> is not correct because phenolphthalein is not orange in alkali and red in acid</p> <p><b>B</b> is not correct because phenolphthalein is not yellow in alkali and red in acid</p> <p><b>D</b> is not correct because phenolphthalein is not colourless in alkali and pink in acid</p>		1 comp

Question number	Answer	Notes	Marks
(c) (i)	M1 ammonium ion is charged $1^+$ / $\text{NH}_4^+$ AND sulfate ion is charged $2^-$ / $\text{SO}_4^{2-}$  M2 so charges balance/cancel (each other) OWTTE	ALLOW so that ammonium sulfate has no overall charge	2 grad
(ii)	[ $[2 \times (14+4) + 32 + (4 \times 16)] = $ ] 132	M2 not dep on M1	1 exp
(iii)	Example calculation  M1 132(g) ammonium sulfate contains 28(g) nitrogen / 1(g) ammonium sulfate contains $(28 \div 132)$ (g) nitrogen  M2 1000(g) ammonium sulfate contains $1000 \times (28 \div 132)$ (g) nitrogen  M3 = 212(.12) (g)  <b>OR</b>  M1 (moles of ammonium sulfate =) $1000 \div 132$ <b>OR</b> 7.58  M2 (mass of nitrogen =) $28 \times 1000 \div 132$ <b>OR</b> $7.58 \times 28$  M3 = 212 (g)	mark CQ from (i)  212 without working scores 3 marks  If 7.58 used in calculation answer is 212.24  If 14 used instead of 28 answer of 106.(06) scores 2 marks with or without working  ALLOW any number of sig figs except 1	3 exp

Total for Q4 = 10

Question number	Answer	Notes	Marks
5 (a)	Any two from M1 all in Group 7/same group M2 because all have 7/same number of electrons in outer shell M3 the number of shells determines the Period they are in		2 Grad
(b) (i)	Ultraviolet radiation	ALLOW UV radiation ALLOW ultraviolet light /UV light/ultraviolet rays/UV rays	1 cler
(ii)	$\text{Cl}_2 + \text{CH}_4 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$	ALLOW multiples	1 Grad
(iii)	M1 attraction between shared pair of electrons M2 and nuclei of the two/both atoms (in the bond) <b>OR</b> M1 bonding/shared pair of electrons M2 attracted to (both) nuclei of atoms (in the bond)	ALLOW M1 attraction of (two) nuclei M2 for shared/bonded pair of electrons (between them)	2 Exp
(iv)	M1 the four shared pairs of electrons between carbon and the other four atoms M2 rest of molecule correct including the three lone pairs of electrons around chlorine atom	M2 DEP M1 ALLOW any combination of dots and crosses	2 Grad
(v)	M1 weak forces of attraction between molecules/weak intermolecular forces M2 little (heat) energy needed to overcome them	ALLOW weak bonds between molecules /weak intermolecular bonds IGNORE less energy 0 marks if implication is that covalent bonds are weak/broken	2 Exp

(c)	<p>Explanation including</p> <p>M1 (one) electron (per carbon atom) delocalised</p> <p>M2 (so) free to move (between layers)</p>	<p>IGNORE sea of electrons /free electrons</p> <p>M2 DEP on mention of electrons</p> <p>0 marks if mention of ions in graphite</p>	<p>2 Exp</p>
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Total Q5 = 12

Question number	Answer	Notes	Marks
6 (a) (i)	M1 alkanes M2 because fits general formula $C_nH_{2n+2}$	M2 not dep on M1	2 Grad
(ii)	D	ALLOW $C_3H_8$	1 cler
(iii)	M1 (compounds of F with same molecular formula / $C_4H_{10}$ ) but different structural/displayed formulae M2 structural/displayed formula of butane M3 structural/displayed formulae of methylpropane		3 Exp
(b)	a description including the following points  M1 heat/vapourise crude oil  M2 pass into (fractionating) column/tower  M3 fractions/compounds/molecules/hydrocarbons separate because of different boiling points  M4 compound D collected at top of column/in refinery gas fraction	ALLOW boil  ALLOW idea of temperature gradient  All marks could be scored from a suitably labelled diagram  MAX 3 if description of lab process  If confusion with cracking only M1 can be awarded	4 Exp

Question number	Answer	Notes	Marks
6 (c) (i)	addition (polymer)  (ii) poly(propene) / polypropene  (iii) $  \left[ \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{---C---C---} \\    \quad   \\  \text{C} \quad \text{H} \\  / \quad   \quad \backslash \\  \text{H} \quad \text{H} \quad \text{H}  \end{array} \right]_n  $  M1 correct repeat unit  M2 brackets and n and extension bonds	REJECT additional  ALLOW polypropylene          Ignore bond angles ALLOW use of CH <sub>3</sub>  M2 DEP M1	1 Cler  1 grad  2 Exp

Total for Q6 = 14



7	(e)	(i)	M1 line on graph from 45 °C to curve  M2 candidate value of rate from graph at 45 °C (expected value approx. 0.016/7)	ALLOW mark on curve at 45 °C  ACCEPT value to +/- 0.0005	2 exp
		(ii)	M1 substitute answer from (i) into (time = 1 ÷ rate)  M2 correct value	ACCEPT answers to 2 or more sig figs  rate = 0.016 time = 62.5 rate = 0.0165 time = 60.6 rate = 0.017 time = 58.8	2 exp
		(iii)	as temperature increases rate of reaction increases	ORA ALLOW positive correlation  REJECT linear/directly proportional	1 grad
	(f)	explanation including following points  (when temperature increases)  M1 (mean) kinetic energy of particles increases  M2 (so) more successful collisions per second/unit time / more frequent successful collisions  M3 rate (of reaction) increases	ALLOW particles move faster  IGNORE vibrate more/faster  ALLOW reference to more frequent collisions between particles having energy ≥ activation energy  ALLOW reaction is faster /speeds up	3 exp	

Total Q7 =14

Question number	Answer	Notes	Marks						
8 (a) (i)	measuring cylinder	ALLOW pipette/burette	1 cler						
(ii)	to ensure temperature same throughout solution OWTTE	ACCEPT to ensure heat evenly distributed throughout solution OWTTE	1 grad						
(iii)	blue	IGNORE qualifiers eg light/dark  REJECT blue-green	1 cler						
8 (b)	<table border="1" data-bbox="363 835 991 1126"> <tr> <td data-bbox="363 835 751 896"><b>Maximum temperature in °C</b></td> <td data-bbox="751 835 991 896">27.3</td> </tr> <tr> <td data-bbox="363 896 751 1010"><b>Initial temperature in °C</b></td> <td data-bbox="751 896 991 1010">24.4</td> </tr> <tr> <td data-bbox="363 1010 751 1126"><b>Increase in temperature in °C</b></td> <td data-bbox="751 1010 991 1126">2.9</td> </tr> </table> <p data-bbox="363 1160 464 1189">M1 27.3</p> <p data-bbox="363 1223 464 1252">M2 24.4</p> <p data-bbox="363 1285 448 1314">M3 2.9</p>	<b>Maximum temperature in °C</b>	27.3	<b>Initial temperature in °C</b>	24.4	<b>Increase in temperature in °C</b>	2.9	<p data-bbox="1023 835 1289 958">If readings are correct but in reverse order award 1 mark for M1 and M2</p> <p data-bbox="1023 1285 1305 1346">ALLOW ECF for M3 if M1 and/or M2 incorrect</p>	3 grad
<b>Maximum temperature in °C</b>	27.3								
<b>Initial temperature in °C</b>	24.4								
<b>Increase in temperature in °C</b>	2.9								

Question number	Answer	Notes	Marks
8 (c) (i)	<ul style="list-style-type: none"> <li>substitution into <math>Q = mc\Delta T</math></li> <li>calculation of heat energy in Joules</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>Q = 50 \times 4.2 \times 3.3</math></p> <p><b>M2</b> 693 J</p>	693 without working scores 2 marks	2 exp
(ii)	<ul style="list-style-type: none"> <li>calculate the amount, in moles, of <math>\text{CuSO}_4</math></li> <li>divide Q by the amount in moles</li> <li>conversion to KJ</li> <li>give the correct sign</li> </ul> <p>Example calculation</p> <p><b>M1</b> <math>1.70 \div 159.5</math> <b>OR</b> 0.0107</p> <p><b>M2</b> <math>693 \div 0.0107</math> <b>OR</b> 64766 (J/mol)</p> <p><b>M3</b> 64.8 (kJ/mol)</p> <p><b>M4</b> - 64.8 (kJ/mol)</p>	<p>ALLOW any number of SF throughout except one</p> <p>Mark CQ from (i)</p> <p>ALLOW use of 700</p> <p>use of 700 gives -65.02 693 &amp; 0.011 gives -63 700 &amp; 0.011 gives -63.64</p> <p>correct answer with correct sign and without working scores 4</p> <p>correct answer without sign or incorrect sign and without working scores 3</p>	exp 4
8 (d)	<p><b>M1</b> temperature decreases/falls</p> <p><b>M2</b> (so) endothermic</p>		2 grad

Total Q8 = 14

Question number	Answer	Notes	Marks
9 (a) (i)	<p><b>B</b> decomposition</p> <p><b>A</b> is not correct because when sodium hydrogencarbonate is heated combustion does not take place</p> <p><b>C</b> is not correct because when sodium hydrogencarbonate is heated oxidation does not take place</p> <p><b>D</b> is not correct because when sodium hydrogencarbonate is heated reduction does not take place</p>		1 comp
	(ii) (because) carbon dioxide/gas is produced/given off		1 grad
9 (b) (i)	to obtain a constant mass OWTTE / to show the reaction is complete OWTTE	ACCEPT to ensure only Na <sub>2</sub> CO <sub>3</sub> is left (in crucible)	1 exp
	(ii) M1 advantage: to stop any solid/Na <sub>2</sub> CO <sub>3</sub> /NaHCO <sub>3</sub> spitting out/being lost	ACCEPT to ensure all the NaHCO <sub>3</sub> has reacted /decomposed	2 exp
	M2 disadvantage: the gas(es)/CO <sub>2</sub> /H <sub>2</sub> O/steam could not easily escape OWTTE	REJECT references to stopping gases escaping	

Question number	Answer	Notes	Marks
9 (c) (i)	3.25 (g)		1 exp
(ii)	<ul style="list-style-type: none"> <li>calculate moles of <math>\text{NaHCO}_3</math></li> <li>use equation to determine moles of <math>\text{Na}_2\text{CO}_3</math></li> <li>multiply by <math>M_r</math> to find mass of <math>\text{Na}_2\text{CO}_3</math></li> </ul> <p>Example calculation:</p> <p>M1 <math>3.25 \div 84</math> <b>OR</b> 0.0387 (mol)</p> <p>M2 <math>0.0387 \div 2</math> <b>OR</b> 0.01935 (mol)</p> <p>M3 <math>0.01935 \times 106 = 2.05</math> (g)</p> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>use of equation to relate mass of <math>\text{NaHCO}_3</math> to mass of <math>\text{Na}_2\text{CO}_3</math></li> <li>shows how to find mass of <math>\text{Na}_2\text{CO}_3</math> using 3.25g <math>\text{NaHCO}_3</math></li> <li>correct evaluation of answer</li> </ul> <p>Example calculation:</p> <p>M1 <math>(2 \times 84) / 168</math> (g) <math>\text{NaHCO}_3 \rightarrow 106</math> (g) <math>\text{Na}_2\text{CO}_3</math></p> <p>M2 <math>3.25</math> (g <math>\text{NaHCO}_3</math>) <math>\rightarrow (106 \div 168) \times 3.25</math> (g <math>\text{Na}_2\text{CO}_3</math>)</p> <p>M3 2.05 (g <math>\text{Na}_2\text{CO}_3</math>)</p>	<p>mark CQ on (i)</p> <p>ALLOW any number of sig figs except 1</p> <p>2.05 (g) without working scores 3 marks</p> <p>4.1 (g) without working scores 2 marks</p> <p>mark CQ on (i)</p>	3 exp
9 (d) (i)	<p>M1 percentage yield = <math>4.2 \div 4.8</math> <b>OR</b> 0.875</p> <p>M2 = <math>(0.875 \times 100) = 87.5</math> (%)</p>	ACCEPT 88 (%) Correct answer without working scores 2	2 grad
(ii)	<p>any one from</p> <p>M1 sodium hydrogencarbonate was impure</p> <p>M2 not all sodium hydrogencarbonate reacted/decomposed</p>		1 grad

Total Q9 = 12 marks

Question number	Answer	Notes	Marks								
10 (a)	M1 red lead oxide → lead(II) oxide + M2 oxygen	must have (II)  ACCEPT answers in either order  If formulae given allow 1 mark for O <sub>2</sub> even if formula for lead(II) oxide is incorrect	2 grad								
10 (b)	<ul style="list-style-type: none"> <li>• dividing percentages by Ar</li> <li>• correct results of divisions</li> <li>• divide by smallest to obtain correct ratio/EF</li> </ul> Example of calculation:  <table style="margin-left: 40px; border: none;"> <tr> <td style="padding-right: 100px;">Pb</td> <td>O</td> </tr> <tr> <td>M1 86.6 ÷ 207</td> <td>13.4 ÷ 16</td> </tr> <tr> <td>M2 0.42</td> <td>0.84</td> </tr> <tr> <td>M3 (0.42 ÷ 0.42 =) 1</td> <td>(0.84 ÷ 0.42 =) 2</td> </tr> </table>	Pb	O	M1 86.6 ÷ 207	13.4 ÷ 16	M2 0.42	0.84	M3 (0.42 ÷ 0.42 =) 1	(0.84 ÷ 0.42 =) 2	0 marks if division by atomic numbers or calculation upside down           ACCEPT alternative methods	3 exp
Pb	O										
M1 86.6 ÷ 207	13.4 ÷ 16										
M2 0.42	0.84										
M3 (0.42 ÷ 0.42 =) 1	(0.84 ÷ 0.42 =) 2										
(c) (i)	M1 $\text{Pb}_3\text{O}_4(\text{s}) + 4\text{HNO}_3(\text{aq})$           M2 $2\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{H}_2\text{O}$	both state symbols required  ALLOW upper case letters for state symbols           both numbers required	2 grad								

<p>10 (c) (ii)</p>	<p>description that makes reference to the following three points:</p> <p>M1 warm/heat (nitric) acid</p> <p>M2 add/mix/react (red) lead oxide (and stir)</p> <p>M3 filter to obtain lead(II) nitrate solution</p> <p><b>AND</b> three of the following points:</p> <p>M4 heat/boil (lead(II) nitrate) solution/filtrate</p> <p>M5 until crystals form in a cooled sample/on a glass rod OWTTE</p> <p>M6 leave solution to cool / leave solution for more crystals to form</p> <p>M7(and then) filter off crystals/lead nitrate</p> <p>M8 suitable method of drying the crystals eg using filter paper/using paper towel/in a warm oven</p>	<p>REJECT boil</p> <p>IGNORE references to adding excess(red) lead oxide</p> <p>ALLOW to remove lead(IV) oxide/PbO<sub>2</sub></p> <p>ALLOW to remove (unreacted/excess) red lead oxide/Pb<sub>3</sub>O<sub>4</sub></p> <p>If heat to dryness only M4 can be scored</p> <p>ACCEPT to crystallisation point/to form a saturated solution /until crystals start to form /to remove some of the water</p> <p>M5 DEP M4</p> <p>ACCEPT decant off the solution</p> <p>M7 DEP M6</p> <p>IGNORE references to washing</p> <p>REJECT hot oven or any method of direct heating eg Bunsen</p> <p>ALLOW leave to dry but not just dry the crystals</p> <p>No M8 if crystals are washed after drying</p>	<p>6 exp</p>
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Total for Q10 = 13 marks

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