



Mark Scheme (Results)

Summer 2019

Pearson Edexcel International GCSE in
Chemistry (4CH1) Paper 1CR

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Publications Code 4CH1_1CR_msc_20190822

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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)	melting		1
(ii)	evaporation		1
(iii)	sublimation		1
b	<p>A description that refers to three of the following points</p> <p>M1 (particles) close together</p> <p>M2 (particles) regularly arranged</p> <p>M3 (particles) do not move around</p> <p>M4 (particles) vibrate (about a fixed position)</p>	<p>ALLOW tightly packed/ touching</p> <p>ALLOW arranged in a lattice</p> <p>M1 and M2 can be scored from a diagram</p> <p>ALLOW do not move freely</p> <p>IGNORE references to fixed shape and volume</p>	<p>3</p> <p>Total 6</p>

Question number	Answer	Notes	Marks
2 a i	potassium reacts more vigorously with water than sodium	✓	3
	potassium sinks to the bottom of the water		
	bubbles of oxygen gas are produced		
	a lilac flame is seen	✓	
	potassium moves around	✓	
	potassium oxide solution is formed		
b (i)	any value or range between 11 and 14		1
(ii)	OH ⁻	ACCEPT HO ⁻ IGNORE any name	1
c	$4\text{Na} + (1)\text{O}_2 \rightarrow 2\text{Na}_2\text{O}$	ACCEPT multiples or fractions	1
			Total 6

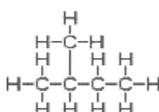
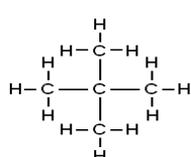
Question number	Answer	Notes	Marks
3 a	<p>A description/diagram which makes reference to the following points</p> <p>M1 put (separate) spots of each of the inks on the (pencil) line. OWTTE</p> <p>M2 pour some solvent into the bottom of the beaker OWTTE</p> <p>M3 place the paper in the beaker so that the spots are (just) above the level of the solvent OWTTE</p> <p>M4 leave until the solvent has risen up the paper (to the top/near the top and then take paper out) OWTTE</p>	<p>ALLOW water for solvent throughout</p> <p>If diagram shows solvent above pencil line only M1 and M2 can be scored</p> <p>DO NOT ALLOW M3 if words and diagram contradict each other</p> <p>ALLOW leave until inks stopped separating OWTTE</p> <p>ALLOW leave until spots/dyes stopped moving OWTTE</p> <p>IGNORE references to leaving for a specified length of time</p>	4

Question number	Answer	Notes	Marks
3 b	<p>An explanation which links the following two points</p> <p>M1 ink would/might dissolve in the solvent OR pencil would not dissolve in the solvent</p> <p>M2 ink would interfere with/contaminate the results OWTTE</p> <p>OR</p> <p>pencil would not interfere with/contaminate the results OWTTE</p>	<p>ALLOW water for solvent</p> <p>ALLOW would produce spots/other colours/get mixed up with inks/move up the paper OWTTE</p> <p>IGNORE smudge/run</p> <p>ALLOW pencil would not produce spots/not produce other colours/not get mixed up with the inks/not move up the paper OWTTE</p>	2

Question number	Answer	Notes	Marks
3 c (i)	<p>For all parts of 3c an explanation which links each of the two points</p> <p>M1 V</p> <p>M2 as it stayed on the start line/did not move</p>	<p>ALLOW blob/dot/mark OWTTE for spot</p> <p>ACCEPT did not produce spots/did not separate</p> <p>ALLOW has R_f value of 0</p> <p>M2 DEP on M1</p>	2
(ii)	<p>M1 X and Z</p> <p>M2 as they both have a dye/spot that travelled the furthest (up the paper)</p>	<p>ALLOW both have spot closest to solvent front</p> <p>ALLOW have highest R_f value(s)</p> <p>M2 DEP on M1</p>	2
(iii)	<p>M1 V and W</p> <p>M2 as they both only form one spot (on the paper)</p>	<p>ACCEPT as W only has one spot and cannot tell about V (as it does not move/is insoluble)</p> <p>ACCEPT reference to the other inks/X, Y, Z form more than one spot</p> <p>M2 DEP on M1</p>	2

Question number	Answer	Notes	Marks
3 d	<ul style="list-style-type: none"> • Working or equation for R_f value • Calculating the R_f value • Giving the answer to 2 significant figures <p>M1 $\frac{4.3}{6.5}$</p> <p>M2 0.6615</p> <p>M3 0.66</p>	<p>Award one mark if correct equation for finding R_f value seen</p> <p>ACCEPT any number of sig fig</p> <p>must be 2 sig fig</p> <p>0.66 with no working scores 3</p> <p>correct answer given to 3 or more sig fig with no working scores 2</p> <p>M3 subsumes M2</p> <p>can score M2 and M3 ECF provided use 4.3 and 6.5 and do a division</p>	<p style="text-align: center;">3</p> <p style="text-align: right;">Total 15</p>

Question number	Answer	Notes	Marks
4 a	M1 (a compound containing the elements/atoms) hydrogen and carbon M2 only	ALLOW molecule/substance for compound REJECT element/atom/mixture for compound REJECT ions/molecules for elements/atoms ACCEPT other equivalent words eg solely M2 DEP on mention of hydrogen and carbon in M1	2
b (i)	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ M1 all formulae correct M2 balancing of correct formulae	ALLOW fractions/multiples IGNORE state symbols	2
(ii)	Any two from M1 carbon monoxide M2 carbon M3 water	ACCEPT correct formulae/symbol ALLOW soot for carbon	2
(iii)	reduces/limits capacity of blood to transport oxygen OWTTE	ACCEPT prevents blood from carrying oxygen OWTTE ACCEPT correct references to haemoglobin eg prevents haemoglobin from carrying oxygen	1
	M1		2

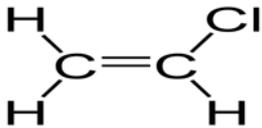
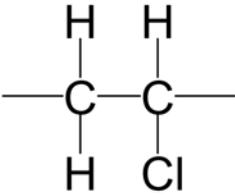
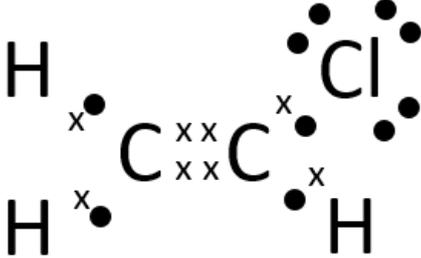
b(iv)			
	<p>M2</p> 	in either order	
c	<p>(i) C_nH_{2n}</p> <p>(ii) (contains a carbon to carbon) double bond</p> <p>(iii) A description linking the following two points</p> <p>M1 add bromine water/solution</p> <p>M2 (bromine water/solution) is decolourised / turns (from orange to) colourless</p>	<p>ALLOW (contains a carbon to carbon) multiple bond</p> <p>ALLOW $Br_2(aq)$</p> <p>IGNORE clear</p> <p>REJECT discoloured</p> <p>If initial colour of bromine water given it must be correct-</p> <p>ALLOW any combination of orange/yellow/brown</p> <p>M2 dep on M1 or near miss</p> <p>ALLOW M1 add acidified potassium manganate(VII)</p> <p>M2 (potassium manganate(VII)) is decolourised/turns (from purple to) colourless</p> <p>REJECT any other initial colour</p>	<p>1</p> <p>1</p> <p>2</p> <p>Total 13</p>

Question number	Answer	Notes	Marks
5 a (i)	<p>An explanation linking the following two points</p> <p>M1 to stop acid (spray) leaving the flask OWTTE</p> <p>M2 as (without cotton wool) mass loss would be too large OWTTE</p>	<p>ALLOW so that only gas can escape (from flask) OWTTE</p> <p>ALLOW so the only cause of mass loss is gas (escaping)</p> <p>REJECT stops gas escaping</p> <p>REJECT references to substances/impurities/gases entering flask</p> <p>ALLOW as with cotton wool the mass does not decrease by more than it should OWTTE</p>	2
a (ii)	<p>B gas is given off</p> <p>A is incorrect as particles moving does not result in mass loss C is incorrect as heat energy being produced does not result in mass loss D is incorrect as marble chips dissolving does not result in mass loss</p>		1
b	<p>$\text{CaCO}_3 (\text{s}) + 2\text{HCl} (\text{aq}) \rightarrow \text{CaCl}_2 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$</p> <p>All 5 correct scores 2 4, 3 correct scores 1</p>	<p>ALLOW upper case</p>	2

Question number	Answer	Notes	Marks
5 c	<p>M1 curve steeper than the original curve</p> <p>M2 levels off at the same mass loss/place as original curve</p>		2
d (i)	<p>An explanation linking the following three points</p> <p>M1 (rate) increases</p> <p>M2 more particles in the same volume</p> <p>M3 more (successful) collisions per unit time / more frequent (successful) collisions</p>	<p>ALLOW particles closer together</p> <p>If reference to particles move faster/have more energy MAX 1</p> <p>IGNORE references to increased chance/probability of collisions</p>	3
(ii)	<p>An explanation linking the following three points</p> <p>M1 (rate) increases</p> <p>M2 (mean kinetic) energy of particles increases</p> <p>M3 more successful collisions per unit time / more frequent successful collisions OWTTE</p>	<p>ALLOW particles move faster</p> <p>ALLOW more particles have energy \geq activation energy</p> <p>ALLOW reference to more frequent collisions between particles having \geq activation energy</p>	3
			Total 13

Question number	Answer	Notes	Marks																											
6 (a)	<ul style="list-style-type: none"> • Dividing percentages by atomic masses • Correct results of divisions • Obtaining ratio by dividing results by smallest value <p>M1</p> <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">C</td> <td style="padding-right: 10px;">H</td> <td>Cl</td> </tr> <tr> <td style="text-align: center;"><u>38.4</u></td> <td style="text-align: center;"><u>4.8</u></td> <td style="text-align: center;"><u>56.8</u></td> </tr> <tr> <td style="text-align: center;">12</td> <td style="text-align: center;">1</td> <td style="text-align: center;">35.5</td> </tr> </table> <p>M2</p> <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">3.2</td> <td style="padding-right: 10px;">4.8</td> <td>1.6</td> </tr> </table> <p>M3</p> <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="text-align: center;"><u>3.2</u></td> <td style="text-align: center;"><u>4.8</u></td> <td style="text-align: center;"><u>1.6</u></td> </tr> <tr> <td style="text-align: center;">1.6</td> <td style="text-align: center;">1.6</td> <td style="text-align: center;">1.6</td> </tr> </table> <p style="margin-left: 20px;">(= 2 3 1)</p> <p>Alternative method</p> <ul style="list-style-type: none"> • Calculating Mr of C₂H₃Cl • Working for finding ratio of each element • Evaluation of correct percentages <p>M1 C₂H₃Cl (= 24 + 3 + 35.5) = 62.5</p> <p>M2</p> <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">C</td> <td style="padding-right: 10px;">H</td> <td>Cl</td> </tr> <tr> <td style="text-align: center;"><u>24</u></td> <td style="text-align: center;"><u>3</u></td> <td style="text-align: center;"><u>35.5</u></td> </tr> <tr> <td style="text-align: center;">62.5</td> <td style="text-align: center;">62.5</td> <td style="text-align: center;">62.5</td> </tr> </table> <p>M3 all x 100</p> <p style="margin-left: 20px;">= 38.4(%) 4.8(%) 56.8(%)</p>	C	H	Cl	<u>38.4</u>	<u>4.8</u>	<u>56.8</u>	12	1	35.5	3.2	4.8	1.6	<u>3.2</u>	<u>4.8</u>	<u>1.6</u>	1.6	1.6	1.6	C	H	Cl	<u>24</u>	<u>3</u>	<u>35.5</u>	62.5	62.5	62.5	0 marks if division by atomic numbers or calculation upside down	3
C	H	Cl																												
<u>38.4</u>	<u>4.8</u>	<u>56.8</u>																												
12	1	35.5																												
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62.5	62.5	62.5																												

Question Number	Answer	Notes	Marks
(b) (i)	FeCl_3	REJECT incorrect use of upper and lower case letters, and superscript ACCEPT correct formula as ions $\text{Fe}^{3+}(\text{Cl}^-)_3$	1
(ii)	to increase the rate of the reaction/ to speed up the reaction	ALLOW references to (providing reaction pathway of) lower activation energy	1
(iii)	gives out heat (energy)	ACCEPT thermal energy NOT energy alone IGNORE reference to negative ΔH	1
(iv)	A addition B is incorrect as this is not a displacement reaction C is incorrect as this is not a neutralisation reaction D is incorrect as this is not a substitution reaction		1
(v)	$\text{C}_2\text{H}_4\text{Cl}_2 \rightarrow \text{C}_2\text{H}_3\text{Cl} + \text{HCl}$	IGNORE incorrect use of lower/upper case and superscripts	1

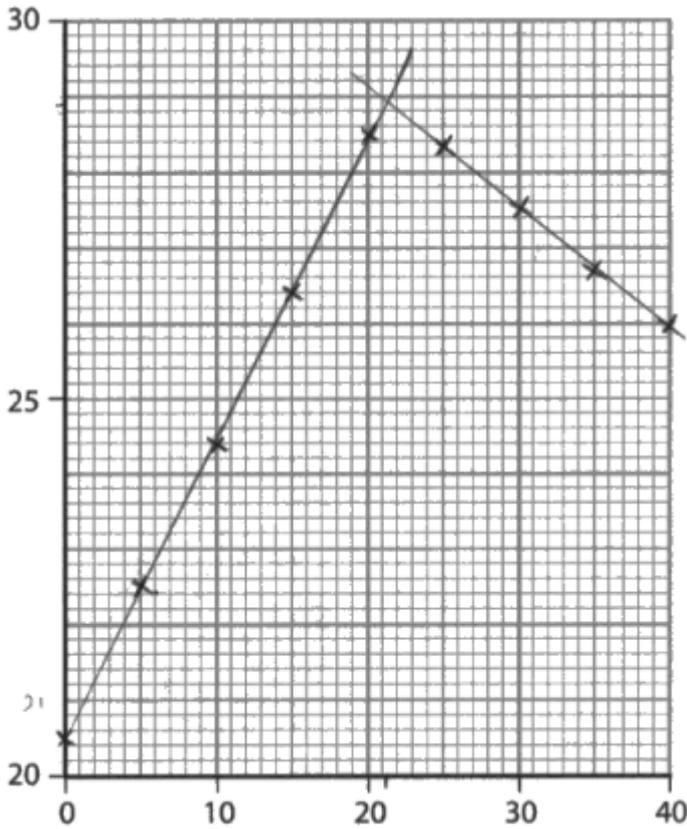
Question number	Answer	Notes	Marks
6 (c) (i)	<p>M1 displayed formula of chloroethene</p>  <p>M2 correct displayed formula with single bond between C atoms</p>  <p>M3 extension bonds shown on C atoms</p>	<p>IGNORE bond angles IGNORE brackets/n</p> <p>If double bond in repeat unit no M2 or M3</p> <p>IGNORE brackets/n</p> <p>more than one correct repeat unit with extension bonds scores 1 mark out of M2/M3</p>	3
(ii)	<p>M1 2 shared pairs between C atoms</p> <p>M2 rest of structure fully correct</p> 	<p>ACCEPT any combination of dots and crosses.</p> <p>IGNORE inner shells even if incorrect</p> <p>M2 DEP on M1</p>	2
Total			13

Question number	Answer	Notes	Marks
7 a (i)	<p>M1 Mg^{2+}</p> <p>M2 NO_3^-</p>		2
7 a (ii)	<p>Part 1 making magnesium nitrate solution - a description linking any three of the following points</p> <p>M1 warm / heat the acid (in a beaker/flask)</p> <p>M2 add magnesium oxide (to acid a little at a time) until in excess /no more dissolves</p> <p>M3 stir</p> <p>M4 filter to remove excess magnesium oxide/excess solid</p>	<p>REJECT boil</p> <p>M3 DEP on use of acid and oxide</p>	6

	<p>Part 2 using (magnesium nitrate) solution/filtrate - a description linking any three of the following points</p> <p>M5 heat/boil (magnesium nitrate solution/filtrate)</p> <p>M6 until crystals form in a cooled sample/on glass rod</p> <p>M7 leave the solution to cool/crystallise</p> <p>M8 filter (to remove crystals)</p> <p>M9 suitable method to dry the crystals eg using filter paper/using paper towel/in warm oven/in a desiccator</p>	<p>NOTE if added excess but not filtered off – MAX 2 for Part 2</p> <p>ACCEPT to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water</p> <p>M6 DEP M5</p> <p>ACCEPT decant the (excess) solution IGNORE references to washing the crystals</p> <p>REJECT hot oven or any method of direct heating e.g. Bunsen</p> <p>ALLOW leave to dry but not just dry the crystals M9 DEP M8 No M9 if then wash crystals after drying</p>	
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7 (b)	(i)	$24 + (2 \times 14) + (6 \times 16) + (12 \times 1) + (6 \times 16)$ or equivalent working	Some working must be seen ALLOW $24 + 124 + 108$	1
	(ii)	<ul style="list-style-type: none"> Calculate moles of magnesium nitrate Setting out of calculation of mass Final answer <p>M1 moles = $(0.05 / 2)$ OR 0.025</p> <p>M2 mass = 0.025×256</p> <p>M3 6.4 (g)</p>	6.4(g) with no working scores 3 only ALLOW ECF M2 from M1	3
	(iii)	<ul style="list-style-type: none"> Setting out of calculation Final answer <p>M1 $\frac{4.8}{6.4} \times 100$</p> <p>M2 75 (%)</p> <p>OR</p> <p>M1 $\frac{4.8}{6} \times 100$</p> <p>M2 80 (%)</p>	75 (%) with or without working scores 2 marks 80 (%) with or without working scores 2 marks ALLOW ECF from b(ii) $\frac{6.4}{4.8} \times 100$ 4.8 AND $\frac{6}{4.8} \times 100$ 4.8 both score 0 Answers of 25% and 20% score 1	2
			Total 14	

Question number	Answer	Notes	Marks
8 (a) (i)	sodium hydroxide + nitric acid → sodium nitrate+ water	ACCEPT correct chemical equation IGNORE ionic equation	1
(ii)	An explanation which links the following two points M1 polystyrene is an insulator M2 less heat is lost (to the surroundings)	ALLOW poor/non- conductor of heat ALLOW no heat lost ALLOW (polystyrene) retains more heat ALLOW reverse arguments for glass beaker	2
(iii)	Any one from (she should) wear eye protection (she should) wear gloves	ACCEPT (safety) goggles ALLOW safety glasses	1

<p>(b) (i)</p> <p>clip</p>	<p>M1 all points plotted correctly to +/- half a square</p> <p>M2 first best fit line drawn with a ruler</p> <p>M3 second best fit line drawn with a ruler</p> 	<p>Award MAX 1 if ruler not used for both</p> <p>DO NOT PENALISE HERE IF LINES DO NOT CROSS</p>	<p>3</p>
<p>(ii)</p>	<p>M1 volume reading read from graph +/- 0.5 (cm³)</p> <p>M2 temp reading read from graph to +/- 0.1 (°C)</p>	<p>Award 1 mark if values correct but reversed.</p> <p>If lines do not meet or cross or a curve is drawn between the lines 0 marks for (ii)</p>	<p>2</p> <p>Total 9</p>

Question number	Answer	Notes	Marks
9 (a)	<p>An explanation linking the following three points</p> <p>M1 covalent bonds are strong</p> <p>M2 many (covalent) bonds (need to be broken)</p> <p>M3 a large amount of (thermal/heat) energy is needed to break the bonds</p>	<p>ACCEPT strong (electrostatic) forces of attraction between the nuclei of atoms and the bonding electrons</p> <p>IGNORE more energy</p> <p>NOT just heat</p> <p>Any mention of intermolecular forces/forces between molecules or ions/ionic bonding /metallic bonding scores 0 out of 3</p>	3

(b)	(i)	<p>An explanation linking the following two points</p> <p>M1 the intermolecular forces (of attraction) are weak</p> <p>M2 therefore little/less (thermal/heat) energy needed to overcome the forces (of attraction)</p>	<p>ACCEPT London forces/dispersion forces/dipole-dipole forces/Van der Waals forces</p> <p>ALLOW the attractions between the molecules are weak</p> <p>ALLOW weak intermolecular bonds</p> <p>NOT just heat</p> <p>ALLOW little/less energy needed to separate the (fullerene) molecules</p> <p>ALLOW little/less energy is required to break the bonds as long as it is clear that the bonds are between molecules</p> <p>Any mention of (breaking of) covalent/ionic/metallic bonds scores 0 out of 2</p>	2
	(ii)	<p>Any one from</p> <p>the medicine can fit inside (the C₆₀ molecule/it)</p> <p>(the C₆₀ molecule/it) will not react with the blood/medicine</p> <p>(the C₆₀ molecule/it) is non-toxic</p>	<p>ALLOW any other sensible suggestion</p> <p>eg C₆₀ molecule/it is inert/unreactive</p>	1

(c)	<p>An explanation linking any five of the following six points but must include M3 and M6 for full marks (graphite is soft because)</p> <p>M1 the structure is in layers</p> <p>M2 there are weak forces/attractions between the layers (of atoms)</p> <p>M3 layers can slide/slip over each other (graphite conducts electricity because)</p> <p>M4 each carbon atom is (covalently) bonded to three other carbon atoms</p> <p>M5 one delocalised electron per carbon atom</p> <p>M6 delocalised electrons flow/move (through the structure)</p>	<p>If reference to weak intermolecular forces or layers of molecules/ions no M2</p> <p>ALLOW air /water (molecules) trapped between the layers</p> <p>ALLOW layers can easily flake off M2/M3 can subsume M1</p> <p>ALLOW one unbonded/free/spare electron per carbon atom</p> <p>ALLOW (only) three (of the carbon) electrons involved in (covalent) bonding</p> <p>ALLOW not all (of the carbon) electrons involved in (covalent) bonding</p> <p>ALLOW are mobile</p> <p>IGNORE free electrons IGNORE sea of electrons IGNORE references to carrying charge/current</p> <p>To score M6 the term delocalised electrons must be seen somewhere If reference to ions for conduction of electricity no M4 M5 M6</p>	<p>5</p> <p>Total 11</p>
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Question number	Answer	Notes	Marks
10 (a) (i)	(because) the zinc (powder) is in excess	ALLOW (because) not all zinc is used up/reacts ALLOW (because) some zinc is left over ALLOW because copper sulfate is limiting reagent/all reacted/all used up	1
(ii)	M1 blue M2 to colourless	ALLOW qualifiers such as dark/light but no other colours IGNORE clear ALLOW no colour ALLOW decolourised REJECT discoloured	2
(b) (i)	<ul style="list-style-type: none"> • Calculation of temperature increase • Substitution into $Q = mc\Delta T$ • Evaluation <p>Example calculation</p> <p>M1 (31.5 – 19.0) OR 12.5</p> <p>M2 $Q = 25 \times 4.18 \times 12.5$</p> <p>M3 $Q = 1310$ (J)</p>	<p>25 x 4.18 x (31.5 – 19.0) scores M1 and M2</p> <p>Calculator answer is 1306.25 ACCEPT any number of sig fig greater than 1</p> <p>Correct answer to 3 or more sig fig without working scores 3</p> <p>1300 with no working scores 0</p> <p>If answer in kJ unit must be given</p> <p>ALLOW use of 4.2 for all 3 marks (= 1312.5)</p>	3

(ii)	$n(\text{CuSO}_4) = (2.00 \div 159.5) = 0.0125$	ACCEPT any number of sig figs except 1	1
(iii)	<ul style="list-style-type: none"> • Division of Q by n • Evaluation including conversion of J to kJ • Answer given with - sign <p>Example calculation</p> <p>M1 $\frac{Q}{n}$ OR $\frac{1300}{0.0125}$ OR $\frac{\text{answer to b(i)}}{\text{answer to b(ii)}}$</p> <p>M2 $\Delta H = (-) 104 \text{ (kJ/mol)}$</p> <p>M3 Negative sign included</p>	<p>ACCEPT any number of sig figs in the numerator except 1</p> <p>ACCEPT any number of sig figs</p> <p>ALLOW ECF from M1</p> <p>Correct answer with no working and no sign or incorrect sign scores 2</p> <p>Correct answer with no working and correct sign scores 3</p> <p>104.5(04) 104.48 104.8 105 all score 2</p> <p>-104.5(04) -104.48 -104.8 -105 all score 3</p>	3
			Total 10

Total marks 110

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