



Mark Scheme (Results)

Summer 2019

Pearson Edexcel International GCSE in
Chemistry (4CH1)
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)	B (the crystal dissolves in water) A is not correct as the crystal does not condense C is not correct as the crystal does not evaporate D is not correct as the crystal does not melt		1
(b) (i)	A (all of the liquid is purple) B is not correct as the crystal will remain dissolved C is not correct as the particles will have diffused throughout the whole of the liquid D is not correct as the particles will have diffused throughout the whole of the liquid		1
(ii)	C (diffusion) A is not correct as condensation describes the process of a gas changing into a liquid B is not correct as crystallisation describes the process of a soluble solid forming from a solution C is not correct as evaporation describes the process of a liquid changing into a gas		1
(c)	A (3) B is not correct as there are only 3 elements present not 4 C is not correct as there are only 3 elements present not 6 D is not correct as there are only 3 elements present not 7		1
		Total	4

Question number	Answer	Notes	Marks
2 a	T		1
b	<p>they have the same number of electrons in their outer shell</p> <p>OR</p> <p>they have one electron in the outer shell</p>	<p>ACCEPT they have the same number of valence electrons/ they have one valence electron</p> <p>ACCEPT outer energy level</p> <p>ALLOW they need to lose 1 electron from the outer shell/ to gain a full outer shell</p>	1
c	<p>An explanation linking the following two points:</p> <p>M1 33</p> <p>M2 because the atomic number of R is two more (than Q)</p> <p>OR because R is two places to the right / two places further on/along (in the period)</p>	<p>ALLOW R has two more protons than Q</p> <p>ACCEPT for each successive element (in the period) there is one more (proton) /the atomic number increases by one</p> <p>ACCEPT they are in the same period but Q is in group 3 and R is in group 5</p> <p>IGNORE reference to electrons</p>	2
		Total	4

Question number	Answer	Notes	Marks										
3 a	Li ⁺	ALLOW Sr ²⁺	1										
b	silver bromide / AgBr	If correct name given ignore incorrect formula	1										
c	lithium bromide / LiBr	Mark CSQ on (a) and (b) If both name and formula given both must be correct	1										
d i	Impurities/ other ions/ other substances could alter/interfere with the colour of the flame /with the results of the test OWTTE	ALLOW impurities/other ions/ other substances contaminate the flame/the test /the wire /it	1										
ii	<table><tr><th>Property</th><th></th></tr><tr><td>good conductor of electricity</td><td></td></tr><tr><td>high density</td><td></td></tr><tr><td>high melting point</td><td>✓</td></tr><tr><td>unreactive</td><td>✓</td></tr></table>	Property		good conductor of electricity		high density		high melting point	✓	unreactive	✓		2
Property													
good conductor of electricity													
high density													
high melting point	✓												
unreactive	✓												
		Total	6										

Question number	Answer	Notes	Marks
4 a	<p>Explanations that link together the following two pairs of points:</p> <p>M1 baseline has been drawn in ink</p> <p>M2 and therefore it will interfere with /contaminate the results</p> <p>M3 the water level is above the ink spots</p> <p>M4 and therefore the inks will mix with the water</p>	<p>ACCEPT not drawn in pencil</p> <p>ACCEPT will produce other colours/will move up the paper/will get mixed up with the ink samples</p> <p>ALLOW pencil will not interfere with the results/ pencil will not dissolve</p> <p>ACCEPT too high/above the baseline</p> <p>ACCEPT the spots are under water</p> <p>ACCEPT the inks will dissolve in the water / the inks will wash off the paper</p>	4
b (i)	3		1
(ii)	A AND B		1
(iii)	<p>An explanation that links together the following two points:</p> <p>M1 C</p> <p>M2 because the spot/ink did not move (up)</p>	<p>ACCEPT did not spread/stayed on the baseline</p> <p>M2 DEP on M1</p>	2
		Total	8

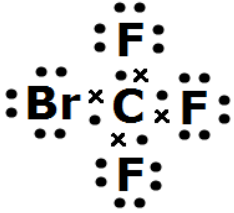
Question number	Answer	Notes	Marks
5 a	<p>C (it has a low density)</p> <p>A is not correct as the colour of the gas is irrelevant</p> <p>B is not correct as the solubility of the gas is irrelevant</p> <p>D is not correct as the smell of the gas is irrelevant</p>		1
b	<p>M1 helium is inert / helium does not react (with air/oxygen)</p> <p>M2 hydrogen is flammable/explosive (in air/oxygen)</p>	<p>ALLOW helium is unreactive</p> <p>ALLOW helium is not flammable/ not explosive</p>	2
c i	$\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$	<p>ACCEPT reversible arrow</p> <p>IGNORE Fe if added to both sides of the equation</p>	1
ii	to increase the rate of reaction / to speed up the reaction / to produce a reaction pathway that has a lower activation energy	ALLOW to lower the activation energy / to make it easier to break the (covalent) bonds (in the molecules)	1
		Total	5

[illegible]

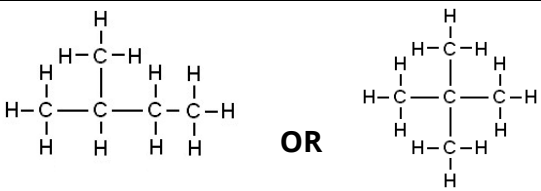
Question number	Answer	Notes	Marks
7 a	<p>An explanation that links together the following two points:</p> <p>M1 (silicon dioxide has) many/strong (covalent) bonds</p> <p>M2 (therefore) a large amount of (heat/thermal) energy is required to break the bonds/ overcome the forces</p>	<p>ACCEPT strong (electrostatic) forces of attraction between the nuclei of atoms and the bonding electrons</p> <p>IGNORE more energy</p> <p>Any mention of intermolecular forces/forces between molecules or ions/ionic bonding /metallic bonding scores 0 out of 2</p>	2
b	<p>An explanation that links together the following two points:</p> <p>M1 (graphite has) delocalised electron(s)</p> <p>M2 that are able to flow (through the structure)</p>	<p>IGNORE sea of electrons</p> <p>IGNORE free electrons</p> <p>ACCEPT are able to move / are mobile</p> <p>IGNORE references to carrying charge/ current</p> <p>M2 dep on mention of electrons Any mention of ions in graphite scores 0 out of 2</p>	2

c	<p>M1 (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons</p> <p>M2 (graphite is soft because) the layers can slide over one another</p>	<p>ALLOW 3D/ rigid/ tetrahedral structure</p> <p>REJECT mention of intermolecular forces in diamond</p> <p>IGNORE mention of intermolecular forces between layers in graphite</p>	2
		Total	6

Question number	Answer	Notes	Marks
8 a	$2\text{C}_2\text{H}_4 + 4\text{HCl} + (1)\text{O}_2 \rightarrow 2\text{C}_2\text{H}_4\text{Cl}_2 + 2\text{H}_2\text{O}$	ACCEPT multiples and fractions	1
b	breaking down by heating OWTTE		1
c i	(it) contains a (carbon to carbon) double bond		1
ii	<p>M1 add bromine water/solution</p> <p>M2 (bromine water/solution) is decolourised/turns (from orange to) colourless</p>	<p>ACCEPT Br₂(aq) as long as the state symbol is present</p> <p>IGNORE clear</p> <p>REJECT discoloured</p> <p>If initial colour of bromine water given it must be correct- 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>	2
d	poly(chloroethene) /polychloroethene	<p>ACCEPT polyvinyl chloride</p> <p>ALLOW PVC</p>	1
		Total	6

Question number	Answer	Notes	Marks
9 a	<p>M1 C $8.05 \div 12$ OR 0.671</p> <p>and Br $53.69 \div 80$ OR 0.671</p> <p>and F $38.26 \div 19$ OR 2.01</p> <p>M2 divide all numbers by 0.671 (to obtain ratio 1 : 1 : 3)</p>	<p>ALLOW ECF from M1</p> <p>If division by atomic numbers or numerators and denominators reversed 0 marks</p> <p>Alternative method</p> <p>M1 M_r (of CBrF₃) = 149</p> <p>M2 $\frac{12}{149} \times 100 = 8.05$ (%)</p> <p>and $\frac{80}{149} \times 100 = 53.69$ (%)</p> <p>and $\frac{57}{149} \times 100 = 38.26$ (%)</p>	2
b	 <p>M1 all four bonding pairs correct</p> <p>M2 rest of electrons correct</p>	<p>ACCEPT any combination of dots and crosses</p> <p>IGNORE inner shell electrons even if incorrect</p> <p>M2 DEP on M1</p>	2

Question number	Answer	Notes	Marks
9 c	<p>An explanation that links together the following two points:</p> <p>M1 the intermolecular forces (of attraction) are weak</p> <p>M2 therefore little energy is required to overcome the forces</p>	<p>ACCEPT London forces/dispersion forces/dipole-dipole forces</p> <p>ALLOW intermolecular bonds</p> <p>ALLOW little energy is required to separate the molecules</p> <p>ALLOW little energy is required to break the bonds as long as it is clear that the bonds are between molecules</p> <p>IGNORE less energy</p> <p>Any mention of covalent bonds/ionic bonds/metallic bonds breaking scores 0 out of 2</p>	2
		Total	6

Question number	Answer	Notes	Marks
10ai	<p>M1 (compounds/molecules) with the same molecular formula</p> <p>M2 but with different structural/displayed formula</p>	<p>ACCEPT same number and same type of atoms</p> <p>REJECT elements for compounds/molecules once only</p> <p>ACCEPT different structures</p> <p>ACCEPT atoms arranged differently</p> <p>REJECT contradicting statements, e.g. same displayed formula but different structures scores 0 out of 2</p>	2
ii	 <p>M1 correct carbon skeleton</p> <p>M2 all hydrogen atoms and all bonds shown</p>	<p>M2 dep on M1</p>	2
bi	<p>$(C_5H_{12} + Br_2) \rightarrow C_5H_{11}Br + HBr$</p> <p>M1 correct formula of organic product</p> <p>M2 HBr as a product and correctly balanced</p>	<p>deduct 1 mark if cases or subscripts incorrect</p> <p>ACCEPT multiple substitutions of bromine</p> <p>$C_5H_{10}Br_2 + H_2$ scores M1</p>	2
ii	substitution		1
		Total	7

Question number	Answer	Notes	Marks
11 a	<ul style="list-style-type: none"> calculate moles of methane calculate mass of oxygen <p>Example calculation</p> <p>M1 $n[\text{CH}_4] = 32 \div 16$ OR 2 (mol)</p> <p>M2 mass of $\text{O}_2 = 128$ (g)</p> <p>OR answer to M1 x 2 x 32</p> <p>OR</p> <p>M1 16 g (of methane) require 64 g (of oxygen)</p> <p>M2 32 g require 128 (g)</p>	correct answer scores 2	2
b i	<p>An explanation that links together the following two points:</p> <p>M1 the water vapour/steam condenses</p> <p>M2 because it is cooled (by the mixture of ice and water)</p>	<p>ACCEPT because (mixture of ice and water) is at a low temperature/ is cold</p> <p>ALLOW (the mixture of ice and water) is below the boiling point of water/below 100 °C</p>	2
ii	<p>A description that links together the following two points:</p> <p>M1 white (anhydrous copper(II) sulfate)</p> <p>M2 turns blue (in the presence of water)</p>		2

iii	<p>An explanation that links together the following three points:</p> <p>M1 the limewater turns milky</p> <p>M2 (because) carbon dioxide /CO₂ (is present)</p> <p>M3 (and) calcium carbonate/CaCO₃/ an insoluble substance is formed</p>	<p>ACCEPT cloudy</p> <p>ALLOW white precipitate forms</p> <p>A word or chemical equation scores M2 and M3</p>	3
		Total	9

Question number	Answer	Notes	Marks
12 a	<p>An explanation that links together</p> <p>M1 the reaction is endothermic and either of the following points:</p> <p>M2 it takes in thermal energy/heat (from the surroundings)</p> <p>OR</p> <p>M3 as shown by the decrease in temperature (of the reaction mixture)</p>	<p>REJECT exothermic for both marks</p> <p>ALLOW references to cooling</p> <p>No M2 or M3 if the statements contradict each other</p>	2
b	<ul style="list-style-type: none"> • calculation of temperature change • substitution into $Q = mc\Delta T$ • evaluation <p>Example calculation</p> <p>M1 $14.2 - 20.0 = (-)5.8$</p> <p>M2 $Q = 100 \times 4.18 \times (-)5.8$</p> <p>M3 $= (-)2420 \text{ (J)}$</p>	<p>$100 \times 4.18 \times (20 - 14.2)$ scores M1 and M2</p> <p>ACCEPT any number of sig figs greater than 2</p> <p>Calculator answer is 2424.4</p> <p>Negative sign not required</p> <p>If answer in kJ unit must be given.</p> <p>Use of 108 can score M1 and M3 (= 2618)</p> <p>2400 alone scores 0</p> <p>ALLOW use of 4.2 for all 3 marks (= 2436)</p>	3

12 c	<ul style="list-style-type: none"> • calculation of moles (n) of ammonium nitrate • division of Q by n • conversion of J to kJ • answer given with + sign <p>Example calculation</p> <p>M1 $n[\text{NH}_4\text{NO}_3] = 8.00 \div 80$ OR 0.1(00) (mol)</p> <p>M2 $\frac{Q}{n}$ OR $\frac{2420}{0.1(00)}$ OR <u>answer to b</u> answer to M1</p> <p>M3 $\Delta H = (+)24.2$ (kJ/mol)</p> <p>M4 positive sign included</p>	<p>ACCEPT any number of sig figs in the numerator except 1</p> <p>ACCEPT any number of sig figs except 1</p> <p>ALLOW ecf from M2</p> <p>correct answer with no working and no sign or incorrect sign scores 3</p> <p>correct answer with no working and correct sign scores 4</p>	4
		Total	9

Question number	Answer	Notes	Marks
13 a (i)		all points plotted correctly to + or - half a square	1
(ii)		curve of best fit drawn for points plotted	1

Question number	Answer	Notes	Marks
13 b i	<p>M1 curve Y starting at origin and below original curve</p> <p>M2 levelling off at 42 cm³ to + or – half a square</p>		2
ii	<p>M1 curve Z starting at origin and above original curve</p> <p>M2 levelling off at 84 cm³ to + or – half a square</p>	<p>ACCEPT curves unlabelled</p> <p>If curves labelled incorrectly then deduct 1 mark</p>	2
c	<p>Any one from:</p> <p>M1 some gas escapes before the bung is replaced/ before the syringe is connected</p> <p>M2 the magnesium is impure/ the magnesium ribbon has an oxide coating</p>	<p>IGNORE gas escapes unqualified</p> <p>IGNORE magnesium didn't fully react /reaction didn't go to completion</p> <p>ALLOW some gas dissolves in the solution/acid/water</p>	1

Question number	Answer	Notes	Marks
13 d	<p>An explanation that links together the following two points:</p> <p>M1 the acid is in excess</p> <p>M2 therefore a precise/ an accurate measurement of the volume is not required</p>	<p>M2 dep on M1</p>	2
13 e	<p>An explanation that links the following points:</p> <p>M1 the concentration of the acid/hydrogen ions/H^+ (ions) decreases</p> <p>M2 therefore there are fewer (successful) collisions (between the hydrogen ions/H^+ ions and the magnesium atoms)</p> <p>M3 per second/per unit time</p>	<p>ALLOW there are fewer hydrogen ions/H^+ (ions) in the same volume</p> <p>ALLOW the surface area of the magnesium decreases</p> <p>less frequent collisions/ slower collision rate scores M2 and M3</p> <p>M3 dep on M2</p> <p>IGNORE less chance of collision</p> <p>MAX 1 if reference to energy of particles changing</p>	3
		Total	12

Question number	Answer	Notes	Marks
14 a	to increase the rate of reaction	ACCEPT to make the reaction faster/ to speed up the reaction REJECT any reference to increasing the solubility of copper(II) oxide	1
b	(the copper(II) oxide/it) stops disappearing OR mixture turns cloudy (black) OR (black) solid settles (at the bottom of the beaker)	ALLOW stops dissolving REJECT any other colour REJECT any other colour ALLOW copper(II) oxide/ it settles (at the bottom of the beaker) IGNORE precipitate	1
c	to remove excess/unreacted copper(II) oxide/solid/base (from the mixture)	ACCEPT to separate the copper(II) sulfate solution (from the copper(II) oxide/unreacted solid/excess solid)	1
d	blue		1

Question number	Answer	Notes	Marks
14 e	<p>M1 heat/boil the filtrate</p> <p>M2 until crystals form in a cooled sample/ on a glass rod</p> <p>M3 leave the solution to cool/crystallise</p> <p>M4 filter (to remove the crystals)</p> <p>M5 dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry</p>	<p>NOTE: If the solution is heated to remove all the water then only M1 can be awarded</p> <p>NOTE If the solution is left to evaporate all the water without heating only 1 mark can be awarded</p> <p>ACCEPT to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water</p> <p>M2 dep on M1</p> <p>NOTE: If the solution is left to completely evaporate after heating then award MAX 3</p> <p>ACCEPT decant the (excess) solution</p> <p>IGNORE references to washing the crystals</p> <p>REJECT hot oven or any method of direct heating e.g. Bunsen burner</p> <p>No M5 if crystals washed after drying</p>	5

Question number	Answer	Notes	Marks
14 f i	<ul style="list-style-type: none"> calculate the moles of CuO calculate the mass of CuSO₄.5H₂O give the answer to an appropriate number of significant figures <p>Example calculation</p> <p>M1 $n[\text{CuO}] = 9.54 \div 79.5$ OR 0.120 (mol)</p> <p>M2 mass of CuSO₄.5H₂O = 0.120 × 249.5 OR 29.94 (g)</p> <p>M3 = 29.9</p> <p>OR</p> <p>M1 79.5 (g) → 249.5 (g)</p> <p>M2 9.94 (g) → (249.5 ÷ 79.5) × 9.54 (g) OR 29.94 (g)</p> <p>M3 = 29.9</p>	<p>Final answer must be to 3 sig figs</p> <p>Final answer must be to 3 sig figs</p> <p>29.94 with no working scores 2</p> <p>29.9 with no working scores 3</p>	3
ii	<p>M1 $(23.92 \div 29.9) \times 100$ OR $(23.92 \div \textbf{M3 from (i)}) \times 100$</p> <p>M2 = 80(%)</p>	<p>ALLOW use of M2 from (i) 29.94 gives 79.89%</p> <p>ALLOW any number of sig figs</p> <p>ACCEPT answer of 79.7(3)% using 30g</p> <p>Correct answer without working scores 2</p>	2
		Total	14

Question number	Answer		Notes	Marks		
15	a	Test	Observation	1 mark for each correct observation ALLOW red-brown /foxy brown /orange-brown IGNORE red or orange alone ALLOW litmus turns blue Penalise effervescence once only in tests 1 and 2	3	
		addition of acidified barium chloride solution	white precipitate			
		addition of sodium hydroxide solution	brown precipitate			
		Addition of sodium hydroxide and gas tested with universal indicator paper	(universal indicator) turns blue/indigo/purple			
	b	i	6.65 (g)		1	
		ii	5.4(0) (g)		1	
		iii	<ul style="list-style-type: none">calculate moles of (NH₄)₂SO₄.Fe₂(SO₄)₃calculate moles of H₂Odivide moles of water by moles of (NH₄)₂SO₄.Fe₂(SO₄)₃give the value of x to the nearest whole number Example calculation M1 $n[(\text{NH}_4)_2\text{SO}_4.\text{Fe}_2(\text{SO}_4)_3] = 6.65 \div 532$ OR 0.0125 (mol) M2 $n[\text{H}_2\text{O}] = 5.4(0) \div 18$ OR 0.3(00) (mol) M3 $x = 0.3(00) \div 0.0125$ M4 $x = 24$ OR M2 ÷ M1 evaluated correctly and quoted to the nearest whole number			4
			correct answer without working scores 4			
			Total		9	

