Mark Scheme (Results)

Summer 2019

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

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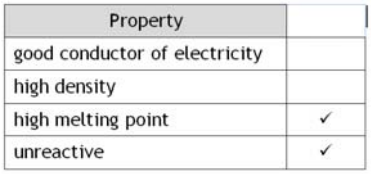
General Marking Guidance

- 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	they have the same number of electrons in their outer shell **OR** they have one electron in the outer shell	**ACCEPT** they have the same number of valence electrons/ they have one valence electron **ACCEPT** outer energy level **ALLOW** they need to lose 1 electron from the outer shell/ to gain a full outer shell	**1**
c	An explanation linking the following two points: **M1** 33 **M2** because the atomic number of R is two more (than Q) **OR** because R is two places to the right / two places further on/along (in the period)	 **ALLOW** R has two more protons than Q **ACCEPT** for each successive element (in the period) there is one more (proton) /the atomic number increases by one **ACCEPT** they are in the same period but Q is in group 3 and R is in group 5 **IGNORE** reference to electrons	**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			**2**
		Total	**6**

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

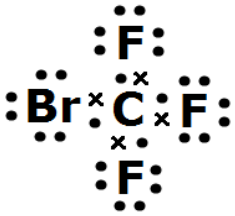
Question number	Answer	Notes	Marks
5 a	**C** (it has a low density) A is not correct as the colour of the gas is irrelevant B is not correct as the solubility of the gas is irrelevant D is not correct as the smell of the gas is irrelevant		**1**
b	**M1** helium is inert / helium does not react (with air/oxygen) **M2** hydrogen is flammable/explosive (in air/oxygen)	**ALLOW** helium is unreactive **ALLOW** helium is not flammable/ not explosive	**2**
c i	$N_2 + 3H_2 \rightarrow 2NH_3$	**ACCEPT** reversible arrow **IGNORE** Fe if added to both sides of the equation	**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**

Question number	Answer	Notes	Marks
6 a	**B** (Z X Y W) A is not correct as Z is the most reactive metal C is not correct as Z is the most reactive metal D is not correct as X is more reactive than Y		**1**
b i	W		**1**
ii	X		**1**
c	**M1** brown/pink/pink-brown solid forms	**ALLOW** red-brown /orange-brown **IGNORE** red or orange alone **ALLOW** precipitate for solid	**2**
	M2 solution turns colourless	**ALLOW** solution becomes paler **IGNORE** clear **IGNORE** incorrect initial colour of solution **IGNORE** references to magnesium disappearing **IGNORE** references to heat	
		Total	**5**

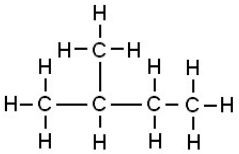
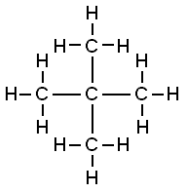
Question number	Answer	Notes	Marks
7 a	An explanation that links together the following two points: **M1** (silicon dioxide has) many/strong (covalent) bonds **M2** (therefore) a large amount of (heat/thermal) energy is required to break the bonds/ overcome the forces	 **ACCEPT** strong (electrostatic)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

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

Question number	Answer	Notes	Marks
8 a	**2** C_2H_4 + **4** HCl + **(1)** O_2 → **2** $C_2H_4Cl_2$ + **2** H_2O	**ACCEPT** multiples and fractions	**1**
b	breaking down by heating OWTTE		**1**
c i	(it) contains a (carbon to carbon) double bond		**1**
ii	**M1** add bromine water/solution **M2** (bromine water/solution) is decolourised/ turns (from orange to) colourless	**ACCEPT** Br_2(aq) as long as the state symbol is present **IGNORE** clear **REJECT** discoloured If initial colour of bromine water given it must be correct- **ALLOW** any combination of orange/yellow/brown **M2** dep on **M1** or near miss **ALLOW** **M1** add acidified potassium manganate(VII) **M2** potassium manganate(VII) is decolourised/turns (from purple) to colourless **REJECT** any other initial colour	**2**
d	poly(chloroethene) /polychloroethene	**ACCEPT** polyvinyl chloride **ALLOW** PVC	**1**
		Total	**6**

Question number	Answer	Notes	Marks
9 a	**M1** C 8.05 ÷ 12 **OR** 0.671 **and** Br 53.69 ÷ 80 **OR** 0.671 **and** F 38.26 ÷ 19 **OR** 2.01 **M2** divide all numbers by 0.671 (to obtain ratio 1 : 1 : 3)	**ALLOW** ECF from **M1** If division by atomic numbers or numerators and denominators reversed 0 marks **Alternative method** **M1** M_r (of $CBrF_3$) = 149 **M2** $\frac{12}{149} \times 100 = 8.05$ (%) **and** $\frac{80}{149} \times 100 = 53.69$ (%) **and** $\frac{57}{149} \times 100 = 38.26$ (%)	**2**
b	 **M1** all four bonding pairs correct **M2** rest of electrons correct	**ACCEPT** any combination of dots and crosses **IGNORE** inner shell electrons even if incorrect **M2** DEP on **M1**	**2**

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

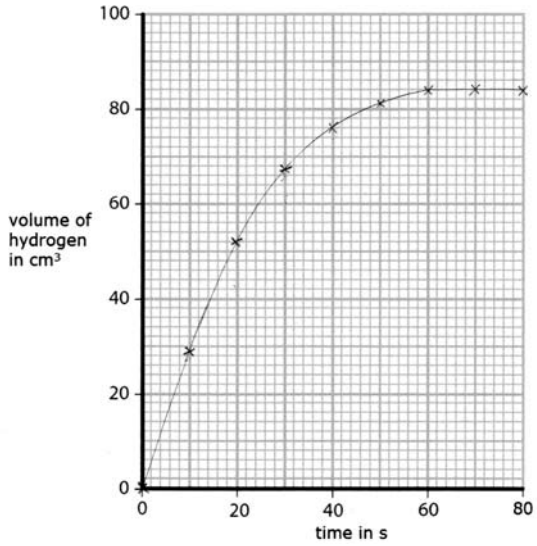
Question number	Answer	Notes	Marks
10ai	**M1** (compounds/molecules) with the same molecular formula **M2** but with different structural/displayed formula	**ACCEPT** same number **and** same type of atoms **REJECT** elements for compounds/molecules once only **ACCEPT** different structures **ACCEPT**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

Question number	Answer	Notes	Marks
11 a	• calculate moles of methane • calculate mass of oxygen Example calculation **M1** $n[CH_4]$ = 32 ÷ 16 OR 2 (mol) **M2** mass of O_2 = 128 (g) **OR** answer to **M1** x 2 x 32 **OR** **M1** 16 g (of methane) require 64 g (of oxygen) **M2** 32 g require 128 (g)	correct answer scores 2	**2**
b i	An explanation that links together the following two points: **M1** the water vapour/steam condenses **M2** because it is cooled (by the mixture of ice and water)	**ACCEPT** because (mixture of ice and water) is at a low temperature/ is cold **ALLOW** (the mixture of ice and water) is below the boiling point of water/below 100 °C	**2**
ii	A description that links together the following two points: **M1** white (anhydrous copper(II) sulfate) **M2** turns blue (in the presence of water)		**2**

iii	An explanation that links together the following three points: **M1** the limewater turns milky **M2** (because) carbon dioxide /CO_2 (is present) **M3** (and) calcium carbonate/$CaCO_3$/ an insoluble substance is formed	 **ACCEPT** cloudy **ALLOW** white precipitate forms A word or chemical equation scores **M2** and **M3**	**3**
		Total	**9**

Question number	Answer	Notes	Marks
12 a	An explanation that links together **M1** the reaction is endothermic and either of the following points: **M2** it takes in thermal energy/heat (from the surroundings) **OR** **M3** as shown by the decrease in temperature (of the reaction mixture)	**REJECT** exothermic for both marks **ALLOW** references to cooling No M2 or M3 if the statements contradict each other	**2**
b	• calculation of temperature change • substitution into $Q = mc\Delta T$ • evaluation Example calculation **M1** 14.2 – 20.0 = (-)5.8 **M2** $Q = 100 \times 4.18 \times (-)5.8$ **M3** = (–)2420 (J)	100 x 4.18 x (20 – 14.2) scores **M1** and **M2** **ACCEPT** any number of sig figs greater than 2 Calculator answer is 2424.4 Negative sign not required If answer in kJ unit must be given. Use of 108 can score **M1** and **M3** (= 2618) 2400 alone scores 0 **ALLOW** use of 4.2 for all 3 marks (= 2436)	**3**

12 c	• calculation of moles (*n*) of ammonium nitrate • division of *Q* by *n* • conversion of J to kJ • answer given with + sign Example calculation **M1** *n*[NH_4NO_3] = 8.00 ÷ 80 **OR** 0.1(00) (mol) **M2** $\frac{Q}{n}$ **OR** $\frac{2420}{0.1(00)}$ **OR** $\frac{\text{answer to b}}{\text{answer to M1}}$ **M3** Δ*H* = (+)24.2 (kJ/mol) **M4** positive sign included	**ACCEPT** any number of sig figs in the numerator except 1 **ACCEPT** any number of sig figs except 1 **ALLOW** ecf from M2 correct answer with no working and no sign or incorrect sign scores 3 correct answer with no working and correct sign scores 4	**4**
		Total	**9**

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

Question number	Answer	Notes	Marks
13 b i	**M1** curve Y starting at origin **and** below original curve **M2** levelling off at 42 cm^3 to + or – half a square		**2**
ii	**M1** curve Z starting at origin **and** above original curve **M2** levelling off at 84 cm^3 to + or – half a square	**ACCEPT** curves unlabelled If curves labelled incorrectly then deduct 1 mark	**2**
c	Any one from: **M1** some gas escapes before the bung is replaced/ before the syringe is connected **M2** the magnesium is impure/ the magnesium ribbon has an oxide coating	**IGNORE** gas escapes unqualified **IGNORE** magnesium didn't fully react /reaction didn't go to completion **ALLOW** some gas dissolves in the solution/acid/water	**1**

Question number	Answer	Notes	Marks
13 d	An explanation that links together the following two points: **M1** the acid is in excess **M2** therefore a precise/ an accurate measurement of the volume is not required	 **M2** dep on **M1**	**2**
13 e	An explanation that links the following points: **M1** the concentration of the acid/hydrogen ions/H^+ (ions) decreases **M2** therefore there are fewer (successful) collisions (between the hydrogen ions/H^+ ions and the magnesium atoms) **M3** per second/per unit time	 **ALLOW** there are fewer hydrogen ions/H^+ (ions) in the same volume **ALLOW** the surface area of the magnesium decreases less frequent collisions/ slower collision rate scores **M2** and **M3** **M3** dep on **M2** **IGNORE** less chance of collision **MAX 1** if reference to energy of particles changing	**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	**M1** heat/boil the filtrate	**NOTE:** If the solution is heated to remove all the water then only **M1** can be awarded **NOTE** If the solution is left to evaporate all the water without heating only 1 mark can be awarded	**5**
	M2 until crystals form in a cooled sample/ on a glass rod	**ACCEPT** to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water **M2** dep on **M1**	
	M3 leave the solution to cool/crystallise	**NOTE**: If the solution is left to completely evaporate after heating then award MAX 3	
	M4 filter (to remove the crystals)	**ACCEPT** decant the (excess) solution **IGNORE** references to washing the crystals	
	M5 dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry	**REJECT** hot oven or any method of direct heating e.g. Bunsen burner No **M5** if crystals washed after drying	

Question number	Answer	Notes	Marks
14 f i	• calculate the moles of CuO • calculate the mass of $CuSO_4.5H_2O$ • give the answer to an appropriate number of significant figures Example calculation **M1** *n*[CuO] = 9.54 ÷ 79.5 OR 0.120 (mol) **M2** mass of $CuSO_4.5H_2O$ = 0.120 × 249.5 **OR** 29.94 (g) **M3** = 29.9 **OR** **M1** 79.5 (g) → 249.5 (g) **M2** 9.94 (g) → (249.5 ÷ 79.5) × 9.54 (g) **OR** 29.94 (g) **M3** = 29.9	Final answer must be to 3 sig figs Final answer must be to 3 sig figs 29.94 with no working scores 2 29.9 with no working scores 3	**3**
ii	**M1** (23.92 ÷ 29.9) × 100 OR (23.92 ÷ **M3** from (i)) × 100 **M2** = 80(%)	**ALLOW** use of **M2** from (i) 29.94 gives 79.89% **ALLOW** any number of sig figs **ACCEPT** answer of 79.7(3)% using 30g Correct answer without working scores 2	**2**
		Total	**14**

Question number	Answer	Notes	Marks
15 a	<table><tr><th>Test</th><th>Observation</th></tr><tr><td>addition of acidified barium chloride solution</td><td>white precipitate</td></tr><tr><td>addition of sodium hydroxide solution</td><td>brown precipitate</td></tr><tr><td>Addition of sodium hydroxide and gas tested with universal indicator paper</td><td>(universal indicator) turns blue/indigo/purple</td></tr></table>	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**
b i	6.65 (g)		**1**
ii	5.4(0) (g)		**1**
iii	• calculate moles of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ • calculate moles of H_2O • divide moles of water by moles of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ • give the value of x to the nearest whole number Example calculation **M1** $n[(NH_4)_2SO_4.Fe_2(SO_4)_3]$ = 6.65 ÷ 532 **OR** 0.0125 (mol) **M2** $n[H_2O]$ = 5.4(0) ÷ 18 **OR** 0.3(00) (mol) **M3** x = 0.3(00) ÷ 0.0125 **M4** x = 24 **OR** **M2** ÷ **M1** evaluated correctly and quoted to the nearest whole number	correct answer without working scores 4	**4**
		Total	**9**

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