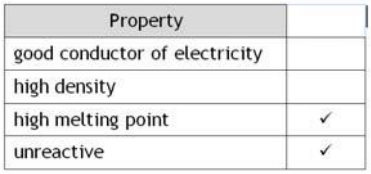
Mark Scheme (Results)

Summer 2019

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

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**

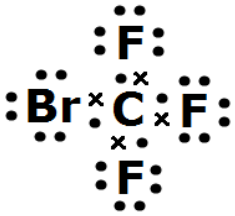
Question number	Answer	Notes	Marks
5 a	**C** (it has a low density) A is not correct as the colour of the gas is irrelevant B is not correct as the solubility of the gas is irrelevant D is not correct as the smell of the gas is irrelevant		**1**
b	**M1** helium is inert / helium does not react (with 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**

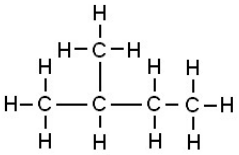
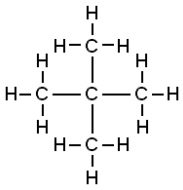
Question number	Answer	Notes	Marks
7 a	An explanation that links together the following two points: **M1** (silicon dioxide has) many/strong (covalent) bonds **M2** (therefore) a large amount of (heat/thermal) energy is required to break the bonds/ overcome the forces	 **ACCEPT** strong (electrostatic) 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**

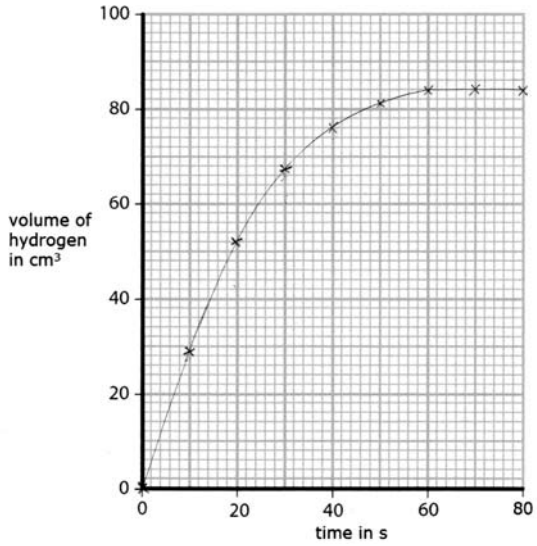
Question number	Answer	Notes	Marks
10ai	**M1** (compounds/molecules) with the same molecular formula **M2** but with different structural/displayed formula	**ACCEPT** same number **and** same type of atoms **REJECT** elements for compounds/molecules once only **ACCEPT** different structures **ACCEPT** 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**