Mark Scheme (Results)

Summer 2019

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

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

Question number	Answer	Notes	Marks
2 a l	potassium reacts more vigorously with water than sodium ✓ 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		3
b (i)	any value or range between 11 and 14		1
(ii)	OH^-	**ACCEPT** HO^- **IGNORE** any name	1
c	**4**Na + (1)O_2 → **2**Na_2O	**ACCEPT** multiples or fractions	1
			Total 6

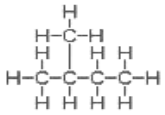
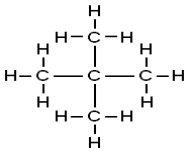
Question number	Answer	Notes	Marks
3 a	A description/diagram which makes reference to the following points **M1** put (separate) spots of each of the inks on the (pencil) line. OWTTE **M2** pour some solvent into the bottom of the beaker OWTTE **M3** place the paper in the beaker so that the spots are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

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

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

Question number	Answer	Notes	Marks
3 d	• Working or equation for R_f value • Calculating the R_f value • Giving the answer to 2 significant figures		3
	M1 $\frac{4.3}{6.5}$	Award one mark if correct equation for finding R_f value seen	
	M2 0.6615	**ACCEPT** any number of sig fig	
	M3 0.66	must be 2 sig fig 0.66 with no working scores 3 correct answer given to 3 or more sig fig with no working scores 2 **M3 subsumes M2** can score **M2 and M3 ECF** provided use 4.3 and 6.5 and do a division	
			Total 15

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 M1	**ACCEPT** prevents blood from carrying oxygen OWTTE **ACCEPT** correct references to haemoglobin eg prevents haemoglobin from carrying oxygen	1 2

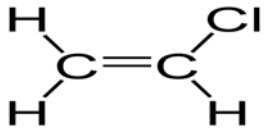
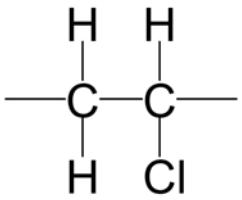
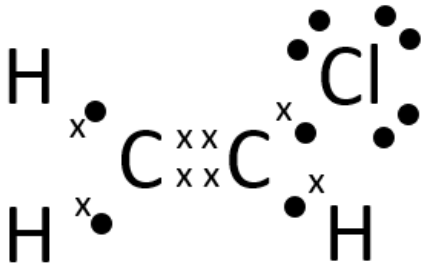
b(iv)			
	M2 	in either order	
c (i)	C_nH_{2n}		1
(ii)	(contains a carbon to carbon) double bond	**ALLOW** (contains a carbon to carbon) multiple bond	1
(iii)	A description linking the following two points **M1** add bromine water/solution **M2** (bromine water/solution) is decolourised / turns (from orange to) colourless	 **ALLOW** $Br_2(aq)$ **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 Total 13

Question number	Answer	Notes	Marks
5 a (i)	An explanation linking the following two points **M1** to stop acid (spray) leaving the flask OWTTE **M2** as (without cotton wool) mass loss would be too large OWTTE	**ALLOW** so that only gas can escape (from flask) OWTTE **ALLOW** so the only cause of mass loss is gas (escaping) **REJECT** stops gas escaping **REJECT** references to substances/impurities/gases entering flask **ALLOW** as with cotton wool the mass does not decrease by more than it should OWTTE	2
a (ii)	B gas is given off 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		1
b	$CaCO_3$ (s) + 2HCl (aq) $\rightarrow CaCl_2$ (aq) + H_2O (l) + CO_2 (g) All 5 correct scores 2 4, 3 correct scores 1	**ALLOW** upper case	2

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

Question number	Answer	Notes	Marks
6 (a)	• Dividing percentages by atomic masses • Correct results of divisions • Obtaining ratio by dividing results by smallest value **M1** C H Cl $\frac{38.4}{12}$ $\frac{4.8}{1}$ $\frac{56.8}{35.5}$ **M2** 3.2 4.8 1.6 **M3** $\frac{3.2}{1.6}$ $\frac{4.8}{1.6}$ $\frac{1.6}{1.6}$ (= 2 3 1) Alternative method • Calculating Mr of C_2H_3Cl • Working for finding ratio of each element • Evaluation of correct percentages **M1** C_2H_3Cl (= 24 + 3 + 35.5) = 62.5 **M2** C H Cl $\frac{24}{62.5}$ $\frac{3}{62.5}$ $\frac{35.5}{62.5}$ **M3** all x 100 = 38.4(%) 4.8(%) 56.8(%)	0 marks if division by atomic numbers or calculation upside down	3

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 $Fe^{3+}(Cl^-)_3$	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 $\triangle H$	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)	$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$	**IGNORE** incorrect use of lower/upper case and superscripts	1

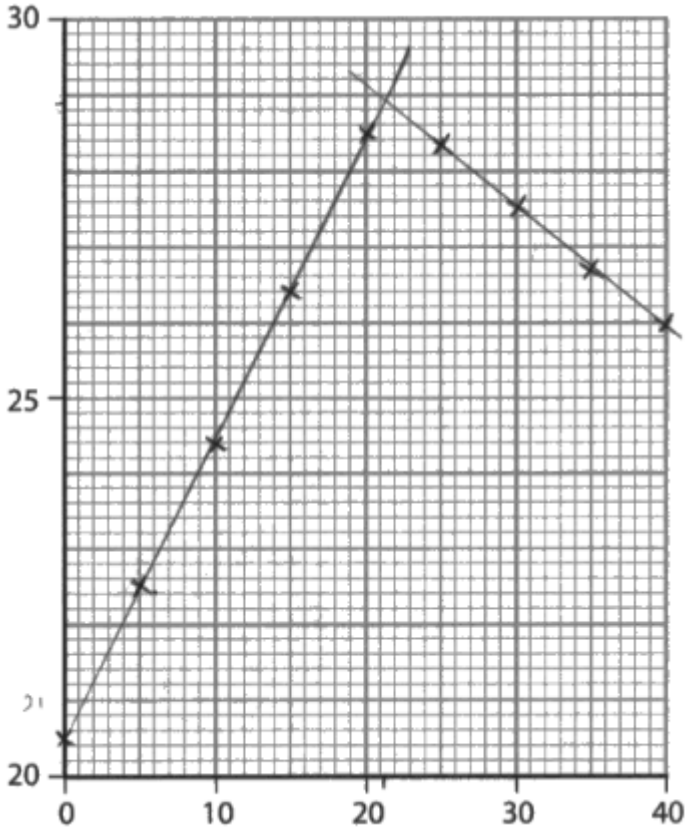
Question number	Answer	Notes	Marks
6 (c) (i)	**M1** displayed formula of chloroethene 	**IGNORE** bond angles **IGNORE** brackets/n	3
	M2 correct displayed formula with single bond between C atoms 	If double bond in repeat unit no **M2** or **M3** **IGNORE** brackets/n	
	M3 extension bonds shown on C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

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

	Part 2 using (magnesium nitrate) solution/filtrate - a description linking any three of the following points M5 heat/boil (magnesium nitrate solution/filtrate) M6 until crystals form in a cooled sample/on glass rod M7 leave the solution to cool/crystallise M8 filter (to remove crystals) M9 suitable method to dry the crystals eg using filter paper/using paper towel/in warm oven/in a desiccator	**NOTE if added excess but not filtered off – MAX 2 for Part 2** **ACCEPT to crystallisation point / to form a saturated solution / until crystals start to form / to remove some of the water** **M6 DEP M5** **ACCEPT decant the (excess) solution IGNORE references to washing the crystals** **REJECT hot oven or any method of direct heating e.g. Bunsen** **ALLOW leave to dry but not just dry the crystals** **M9 DEP M8** **No M9 if then wash crystals after drying**	

7 (b) (i)	24 + (2 x 14) + (6 x 16) + (12 x 1) + (6 x 16) or equivalent working	Some working must be seen **ALLOW** 24 + 124 +108		1
(ii)	• Calculate moles of magnesium nitrate • Setting out of calculation of mass • Final answer **M1** moles = (0.05 / 2) **OR** 0.025 **M2** mass = 0.025 x 256 **M3** 6.4 (g)	6.4(g) with no working scores 3 only **ALLOW** ECF M2 from M1		3
(iii)	• Setting out of calculation • Final answer **M1** $\frac{4.8}{6.4} \times 100$ **M2** 75 (%) OR **M1** $\frac{4.8}{6} \times 100$ **M2** 80 (%)	75 (%) with or without working scores 2 marks 80 (%) with or without working scores 2 marks **ALLOW** ECF from b(ii) $\frac{6.4}{4.8} \times 100$ AND $\frac{6}{4.8} \times 100$ 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

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

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

(b)	(i)	An explanation linking the following two points **M1** the intermolecular forces (of attraction) are weak **M2** therefore little/less (thermal/heat) energy needed to overcome the forces (of attraction)	 **ACCEPT** London forces/dispersion forces/dipole-dipole forces/Van der Waals forces **ALLOW** the attractions between the molecules are weak **ALLOW** weak intermolecular bonds **NOT** just heat **ALLOW** little/less energy needed to separate the (fullerene) molecules **ALLOW** little/less energy is required to break the bonds as long as it is clear that the bonds are between molecules Any mention of (breaking of) covalent/ionic/metallic bonds scores 0 out of 2	2
	(ii)	Any one from the medicine can fit inside (the C_{60} molecule/it) (the C_{60} molecule/it) will not react with the blood/medicine (the C_{60} molecule/it) is non-toxic	 **ALLOW** any other sensible suggestion eg C_{60} molecule/it is inert/unreactive	1

(c)	An explanation linking any **five** of the following six points but must include **M3** and **M6** for full marks (graphite is soft because) **M1** the structure is in layers **M2** there are weak forces/attractions between the layers (of atoms) **M3** layers can slide/slip over each other (graphite conducts electricity because) **M4** each carbon atom is (covalently) bonded to three other carbon atoms **M5** one delocalised electron per carbon atom **M6** delocalised electrons flow/move (through the structure)	If reference to weak intermolecular forces or layers of molecules/ions no **M2** **ALLOW** air /water (molecules) trapped between the layers **ALLOW** layers can easily flake off **M2 / M3** can subsume **M1** **ALLOW** one unbonded/free/spare electron per carbon atom **ALLOW** (only) three (of the carbon) electrons involved in (covalent) bonding **ALLOW** not all (of the carbon) electrons involved in (covalent) bonding **ALLOW** are mobile **IGNORE** free electrons **IGNORE** sea of electrons **IGNORE** references to carrying charge/current To score M6 the term delocalised electrons must be seen somewhere If reference to ions for conduction of electricity no **M4 M5 M6**	5 **Total 11**

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	**ALLOW** qualifiers such as dark/light but no other colours	2
	M2 to colourless	**IGNORE** clear **ALLOW** no colour **ALLOW** decolourised **REJECT** discoloured	
(b) (i)	• Calculation of temperature increase • Substitution into Q = $mc\Delta T$ • Evaluation Example calculation **M1** (31.5 – 19.0) OR 12.5		3
	M2 Q = 25 x 4.18 x 12.5	25 x 4.18 x (31.5 – 19.0) scores **M1** and **M2**	
	M3 Q = 1310 (J)	Calculator answer is 1306.25 ACCEPT any number of sig fig greater than 1 Correct answer to 3 or more sig fig without working scores 3 1300 with no working scores 0 If answer in kJ unit must be given **ALLOW** use of 4.2 for all 3 marks (= 1312.5)	

(ii)	$n(CuSO_4) = (2.00 \div 159.5) = 0.0125$	**ACCEPT** any number of sig figs except 1	1
(iii)	• Division of *Q* by *n* • Evaluation including conversion of J to kJ • Answer given with - sign Example calculation **M1** $\frac{Q}{n}$ **OR** $\frac{1300}{0.0125}$ **OR** $\frac{\text{answer to b(i)}}{\text{answer to b(ii)}}$ **M2** ΔH = (–) 104 (kJ/mol) **M3** Negative sign included	**ACCEPT** any number of sig figs in the numerator except 1 **ACCEPT** any number of sig figs **ALLOW** ECF from **M1** Correct answer with no working and no sign or incorrect sign scores 2 Correct answer with no working and correct sign scores 3 104.5(04) 104.48 104.8 105 all score 2 -104.5(04) -104.48 -104.8 -105 all score 3	3 **Total 10**

Total marks 110

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