Mark Scheme (Results)

January 2020

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)	C Neutron The only correct answer is C because the nucleus contains protons and neutrons. Protons are identified as the white dots A is not correct because electrons occur in the shells B is not correct because a molecule is not a particle found in the nucleus D is not correct because the nucleus contains protons **and** neutrons		1
(b)	A Electron The only correct answer is A because electrons have a relative mass of 1/1836 compared to a proton or a neutron B is not correct because a neutron has a relative mass of 1 C in not correct because the nucleus contains 4 protons and 5 neutrons D is not correct because a proton has a relative mass of 1		1
(c)	C 9 The only correct answer is C because the mass number is the sum of the protons and neutrons A is not correct because the atomic number is 4 B is not correct because 5 is the number of neutrons D is not correct because 13 is the total number of protons, neutrons and electrons		1
(d)	A 4 The only correct answer is A because the atomic number is equal to the number of protons which is 4 B is not correct because 5 is the number of neutrons C is not correct because 9 is the total number of particles in the nucleus D is not correct because 13 is the total number of protons, neutrons and electrons		1
(e) (i)	beryllium/Be		1
(ii)	(positive) ion	**ALLOW** ecf from the element given in (e)(i) **ACCEPT** any positive beryllium ion (or other ecf ion) **REJECT** any negative ion	1

Question number	Answer	Notes	Marks
2 (a) (i)	Particles should be close together and should fill from the bottom of the box, some particles should touch	**ALLOW** particles filling the whole box **IGNORE** the size of the particles **REJECT** a regular arrangement	1
(ii)	Gas	**ALLOW** gaseous	1
(b)	**M1** (water evaporates) l to g **M2** (crystals of iodine sublime) s to g **M3** (ice melts) s to l	**ALLOW** words for M1, M2 and M3	3
(c)	**M1** (particles / molecules have) more energy **M2** to overcome / break the forces (between water molecules)	**ALLOW** water has more energy **ALLOW** (particles / molecules have) move faster **IGNORE** vibrate more **ALLOW** to overcome / break the bonds (between water molecules) **OR** to break away from one another **OR** so escape more easily **IGNORE** references to collisions or activation energy	2

Question number	Answer	Notes	Marks
3 (a)	Most Z_2 Y_2 Least X_2	**ALLOW** Z Y X **ALLOW** lower case letters **IGNORE** size of number **IGNORE** any names given	1
(b)	bromine	**ALLOW** bromine water **OR** bromine solution / Br / Br_2 **REJECT** bromide	1
(c) (i)	(Fluorine) gas / vapour (chlorine) range between -150°C to 10°C inclusive (Astatine) dark grey / black	 **REJECT** blue-black	3
(c) (ii)	C – the halogens have the same number of outer shell electrons. The only correct answer is C because the halogens are in group 7 and have similar reactions because they have the same number of electrons in their outer shells. A is not correct because the fact halogens are non-metals does not make them react in a similar way. B is not correct because the fact halogens are molecules does not make them react in a similar way. D is not correct because elements in the same period have different numbers of outer shell electrons and react differently.		1
(d)(i)	Chlorine is toxic / poisonous	**IGNORE** harmful / dangerous / irritant **IGNORE** any reference to products	1
(d)(ii)	M1 $FeCl_3$ M2 $2Fe + 3Cl_2 \rightarrow 2FeCl_3$ M2 rest of the equation balanced	**ALLOW** correct charges on the ions **REJECT** incorrect capitals **REJECT** large or super-script 3 **ALLOW** multiples or fractions for M2 **M2 dep on M1**	2

Question number	Answer	Notes	Marks
4 (a)	NH_4^+	**ALLOW** NH_4^{+1} and NH_4^{1+}	1
(b)	**M1** add sodium hydroxide solution (and warm) **M2** (test the gas with damp) red litmus **M3** turns blue **OR** **M2** expose the gas to concentrated hydrochloric acid **M3** white smoke produced	 **ALLOW** (test the gas with damp) universal indicator If universal indicator is used allow blue / purple for **M3** **M3** dep on litmus or universal indicator in **M2** If sodium hydroxide solution is not added **max = 1**	3
(c)	(the reaction is) reversible	**ACCEPT** reaction that goes both ways / both forwards and backwards reactions occur **IGNORE** references to equilibrium	1
(d)(i)	**M1** (molecules / particles of) ammonia move / diffuse faster **M2** because the ammonium chloride forms near(er) to the HCl **OR** because the ammonia has travelled further (in the same time)	 **IGNORE** references to the masses / sizes of the particles	2
(d)(ii)	Any **two** from: **M1** (gas particles) move in random directions / don't travel in straight lines OWTTE **M2** (gas particles) collide with air / other particles **M3** (gas particles) collide with the walls / sides (of the tube) OWTTE	 **ALLOW** air / other particles slow them down **IGNORE** any references to rate of reaction / collisions	2

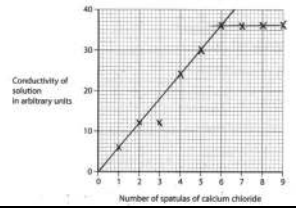
Question number	Answer	Notes	Marks
5 (a)	Results are the same at the end	**ALLOW** there is a constant volume in the tube **ALLOW** the volume of gas stops decreasing **ALLOW** no change after 4 / 5 minutes **IGNORE** references to time **REJECT** the volume of gas stops increasing	1
(b)	(use a glass tube / scale with) smaller divisions.	**ALLOW** use a glass tube / scale with 0.1cm^3 divisions **ALLOW** use a smaller scale **IGNORE** references to repeating the experiment **IGNORE** references to temperature	1
(c)	**M1** Volume of oxygen = 11.5(cm^3) **M2** (11.5 ÷ 48.5) x 100 **M3** 23.7%	Correct answer to 1 dp with or without working scores 3 **ALLOW** ecf from M1 **M3** must be to 1dp	3

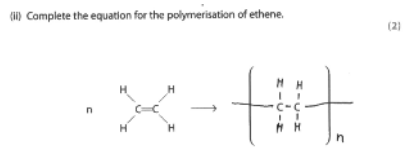
Question number	Answer	Notes	Marks
6 (a) (i)	magnesium is more reactive than copper	**ALLOW** magnesium can displace copper **ALLOW** magnesium is higher than copper in the reactivity series **REJECT** magnesium is more reactive than copper(II) **or** Cu^{2+} **or** copper sulfate	1
(ii)	magnesium sulfate + copper	Both are required for the mark. Either order. **REJECT** copper(II) **IGNORE** any chemical formulae given	1
(b) (i)	**M1** Temperature rise = 36.1(°C)	Correct answer with or without working scores 2	2
	M2 15 162J	**ALLOW** ecf from M1 **ALLOW** 2 or more significant figures **IGNORE** negative sign	
(ii)	An explanation that links any **two** of the following points		2
	M1 polystyrene is an insulator	**ALLOW** polystyrene is not a (good) conductor of heat **ALLOW** polystyrene is a poor conductor of heat	
	M2 (so) reduces heat loss (to the surroundings) OWTTE	**ALLOW** prevents heat loss **ALLOW** keeps heat in	
	M3 temperature rise/change/reading will be closer to true value OWTTE	**ALLOW** temperature rise/change/reading will be more accurate/valid	

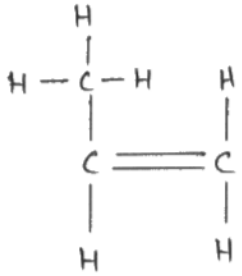
(c)(i)	**M1** calculate the amount, in moles, of zinc **M2** divide Q by the amount in moles **M3** give the answer to three significant figures with a - sign Example calculation **M1** 0.500 ÷ 65 **OR** 0.00769 **M2** 1.67 ÷ 0.00769 **OR** 217 (kJ/mol) **M3** **-**217 (kJ/mol) **OR** **M1** 1.67 ÷ 0.5 **OR** 3.34 kJ/g) **M2** 3.34 × 65 **OR** 217 (kJ/mol) **M3** -217 (kJ/mol)	 **M2** subsumes **M1** Correct answer of -217 with or without working scores 3 marks. Allow ECF throughout	3
(c)(ii)	**M1** zinc is oxidised **and** Cu^{2+} is reduced **M2** Zinc loses electrons **M3** Cu^{2+} gains electrons	**ALLOW** zinc is oxidised and copper(sulfate) is reduced in **M1** **ALLOW** oxidation and reduction occur **ALLOW** references to changes in oxidation number for **M2** and **M3** Must mention copper ions for M3	3

Question number			Answer	Notes	Marks
7	(a)	(i)	Measuring cylinder / burette / (volumetric) pipette		1
		(ii)	Neutralisation	**ACCEPT** exothermic **IGNORE** base or alkali	1
	(b)	(i)	12.4		1
		(ii)	$15cm^3$ - red/orange $30cm^3$ - blue/purple		2
		(iii)	OH^- / hydroxide (ion)	**REJECT** OH	1
	(c)		**M1** the reaction is exothermic (therefore the temperature rises)	**ALLOW** the reaction gives out heat (energy) **or** thermal energy **IGNORE** energy alone	3
			M2 (after $25cm^3$ of sodium hydroxide) the reaction is complete OWTTE	**ALLOW** (after $25cm^3$ of sodium hydroxide) neutralisation happens	
			M3 so adding more sodium hydroxide / liquid / solution cools the mixture down	**ALLOW** so no more heat (energy) **or** thermal energy is given out OWTTE **IGNORE** energy alone	

Question number	Answer	Notes	Marks
8 (a)	**M1** calcium loses electrons **M2** chlorine gains electrons **M3 two** atoms of chlorine each gain **one** electron **OR** **M3** calcium loses 2 electrons and chlorine gains 1 electron	**IGNORE** references to redox Allow 1 mark from **M1** and **M2** for electron transfer from chlorine to calcium If chlorine molecules are gaining electrons do not award **M3** Any reference to sharing electrons or covalent or metallic bonding scores 0	3
(b)	(test for Ca^{2+} ions) **M1** flame test (allow description of a flame test) **M2** orange-red flame colour (test for Cl^- ions) **M3** add silver nitrate **M4** white precipitate	 **ALLOW** brick-red **IGNORE** orange / red alone **M2** dep on **M1** **ALLOW M1** add sodium hydroxide **ALLOW M2** (slight) white precipitate (reject precipitate dissolves in excess sodium hydroxide) **IGNORE** reference to nitric acid **REJECT** hydrochloric acid or sulfuric acid **M4** dep on silver nitrate in **M3**	4

(c)(i)		**M1** and **M2** all points correct ± half a square **M3** 2 straight lines of best fit ignoring the anomalous point  	One plotting error scores **M1**	3
(c)	(ii)	the conductivity is (directly) proportional (to the number of spatulas of calcium chloride added) **OR** the conductivity increases (as the number of spatulas of calcium chloride increases)		1
	(iii)	Any **one** from**:** **M1** The student took the reading before adding the calcium chloride **M2** The student forgot to stir the mixture **OR** did not stir the mixture properly	**IGNORE** any references to human error	1
(d)		**M1** Heat (the calcium chloride) **M2** until molten / melts	**IGNORE** references to electrons / ions	2

Question number			Answer	Notes	Marks
9	(a)	(i)	**M1** (Empirical formula) CH_2 **M2** (General formula) C_nH_{2n}	**ALLOW** sub and super script numbers for M1 and M2 **ALLOW** letters other than n **ALLOW** capital letters	2
		(ii)	Any two from: **M1** each member differs from the next by a CH_2 group OWTTE **M2** (each member has) same functional group **M3** (each member has) similar/same chemical properties / similar/same (chemical) reactions **M4** trend in physical properties (between successive members)	 **ACCEPT** react in similar/same way **ACCEPT** named physical property, e.g. boiling point **REJECT** similar/same physical properties	2
	(b)	(i)	addition	**ALLOW** additional **REJECT** condensation	1
		(ii)	 **M1** Single bond between the two carbons, 4 hydrogens joined by single bonds **M2** trailing bonds through the brackets and the n to the right	 **ALLOW** n in any position outside the bracket to the right of the structure. **ALLOW** capital N	2
		(iii)	Any 5 points from: **M1** Poly(ethene) is cheaper than polymers from corn starch **M2** Poly(ethene) is stronger than polymers from corn starch **M3** Poly(ethene) frees up land to grow food crops	If only advantages or disadvantages given, max 3 marks **IGNORE** durable	5

	M4 Poly(ethene) comes from (cracking of certain fractions from) crude oil **M5** Poly(ethene) is non-renewable **OR** ethene is a finite source **M6** Poly(ethene) is inert **M7** poly(ethene) is non-biodegradable **M8** poly(ethene) takes longer to decompose **M9** Disposal of poly(ethene) is a problem (in landfill) **M10** Poly(ethene) causes problems with litter **M11** Burning poly(ethene) (could) create toxic fumes / greenhouse gases		
(c)		Must show every bond. **IGNORE** bond angles **IGNORE** n **IGNORE** brackets **REJECT** trailing bonds	1

Question number	Answer	Notes	Marks
10 (a) (i)	**M1** four electrons between the carbon and each oxygen **M2** rest of molecule correct	 **M2** dep on **M1**	2
(ii)	**M1** shared pair(s) of electrons **M2** attracted to (two) nuclei	 **REJECT** nucleus. Must be plural for **M2**. **M2** dep on mention of electrons in **M1**	2
(b) (i)	**M1** Graphite has delocalised electrons **M2** (delocalised electron(s)) can move or flow (throughout the structure)	**IGNORE** sea of electrons **IGNORE** free electrons **IGNORE** number of electrons **IGNORE** references to carrying a charge or current **IGNORE** references to layers **M2** dep on mentioning electrons in **M1** Any mention of ions scores 0	2
(ii)	**M1** (diamond) giant covalent **M2** (in melting diamond) covalent bonds are broken **M3** (C_{60}) (simple) molecular structure **M4** (in melting C_{60}) intermolecular forces (of attraction) are overcome **M5** more energy is needed to break covalent bonds (in diamond) than intermolecular forces (in C_{60})	**ALLOW** macromolecular **ALLOW** giant structure if M2 is scored **IGNORE** tetrahedral structure **REJECT** molecules of diamond **ALLOW** description of covalent bonds **ALLOW** molecules of C_{60} **ALLOW** strong covalent bonds and weak intermolecular forces (or attraction)	5

		ACCEPT breaking bonds in C_{60} if intermolecular forces clearly mentioned Mention of intermolecular forces in diamond no **M2** or **M5** Mention of breaking covalent bonds in C_{60} no **M4** or **M5**	

Question number	Answer	Notes	Marks
11 (a)	**4** CuO (**s**)+ CH_4 (**g**)→ **4** Cu (**s**)+ CO_2 (**g**) + **2** H_2O (**l/g**) **M1** correct balancing **M2** correct state symbols	**ALLOW** multiples and fractions	2
(b) (i)	**M1** Mass copper 3.18g **and** mass oxygen 0.40g **M2** Moles copper = 3.18/63.5 **OR** 0.0500 moles **M3** Moles oxygen = 0.40/16 **OR** 0.025 moles **M4** Ratio of moles Cu:O is 2:1	 **M2** and **M3** allow ecf from **M1** **M4** is dep on **M2** and **M3**	4
(ii)	Any one from: **M1** Use a safety screen **M2** Position the class some distance from the apparatus **M3** Do the experiment in a fume cupboard **M4** Set fire to the (excess) methane gas straight away	 **ALLOW** tie hair back **ALLOW** wear heat-proof gloves	1
(c)(i)	(Iron (III) oxide) loses oxygen	**ALLOW** iron loses oxygen **IGNORE** any reference to electrons.	1
(ii)	Carbon monoxide is poisonous / toxic **OR** carbon monoxide reduces the ability of the blood to carry oxygen	**ALLOW** carbon monoxide binds to haemoglobin in the blood	1

(iii)	• calculate M_r of Fe_2O_3 • calculate the amount, in moles, of Fe_2O_3 • calculate the amount, in moles, of Fe • calculate the mass in tonnes of Fe Example calculation **M1** M_r of Fe_2O_3 = 160 **M2** $n(Fe_2O_3)$ = 30.0 x 10^6 ÷ 160 **OR** 187,500 moles **M3** n(Fe) = 187,500 x 2 **OR** 375,000 moles **M4** 375,000 x 56 = 21 tonnes	Correct answer of 21 tonnes scores 4 marks with or without working **ALLOW** ecf from **M1** (incorrect M_r) **ALLOW** working in megamoles **ALLOW** ecf from M1 **ALLOW** working in megamoles **ALLOW** ECF from M2 **ALLOW** ecf from M3	4
(iv)	**M1** 840,000g is 70,000 moles of carbon **M2** therefore need 23,333 moles Fe_2O_3 (but we have 25,000 which is an excess) **OR** **M1** Need 75,000 moles carbon **M2** 900,000g of carbon is needed (and have 840,000g of carbon so iron(III) oxide is in excess as carbon is the limiting reactant) **OR** **M1** need 75,000 moles of carbon **M2** have 840,000÷12 **OR** 70,000 moles of carbon (so iron(III) oxide is in excess as carbon is the limiting reactant)		2

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