



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)	<p>C Neutron The only correct answer is C because the nucleus contains protons and neutrons. Protons are identified as the white dots</p> <p>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</p>		1
(b)	<p>A Electron The only correct answer is A because electrons have a relative mass of 1/1836 compared to a proton or a neutron</p> <p>B is not correct because a neutron has a relative mass of 1 C is not correct because the nucleus contains 4 protons and 5 neutrons D is not correct because a proton has a relative mass of 1</p>		1
(c)	<p>C 9 The only correct answer is C because the mass number is the sum of the protons and neutrons</p> <p>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</p>		1
(d)	<p>A 4 The only correct answer is A because the atomic number is equal to the number of protons which is 4</p> <p>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</p>		1
(e) (i)	beryllium/Be		1
(ii)	(positive) ion	<p>ALLOW ecf from the element given in (e)(i)</p> <p>ACCEPT any positive beryllium ion (or other ecf ion)</p> <p>REJECT any negative ion</p>	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)	<u>Chlorine</u> is toxic / poisonous	IGNORE harmful / dangerous / irritant IGNORE any reference to products	1
(d)(ii)	M1 FeCl ₃ M2 2Fe + 3Cl ₂ → 2FeCl ₃ M2 rest of the equation balanced	ALLOW correct charges on the ions REJECT incorrect capitals REJECT large or superscript 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)	<p>M1 add sodium hydroxide solution (and warm)</p> <p>M2 (test the gas with damp) red litmus</p> <p>M3 turns blue</p> <p>OR</p> <p>M2 expose the gas to concentrated hydrochloric acid</p> <p>M3 white smoke produced</p>	<p>ALLOW (test the gas with damp) universal indicator</p> <p>If universal indicator is used allow blue / purple for M3</p> <p>M3 dep on litmus or universal indicator in M2</p> <p>If sodium hydroxide solution is not added max = 1</p>	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)	<p>M1 (molecules / particles of) ammonia move / diffuse faster</p> <p>M2 because the ammonium chloride forms near(er) to the HCl OR because the ammonia has travelled further (in the same time)</p>	IGNORE references to the masses / sizes of the particles	2
(d)(ii)	<p>Any two from:</p> <p>M1 (gas particles) move in random directions / don't travel in straight lines OWTTE</p> <p>M2 (gas particles) collide with air / other particles</p> <p>M3 (gas particles) collide with the walls / sides (of the tube) OWTTE</p>	<p>ALLOW air / other particles slow them down</p> <p>IGNORE any references to rate of reaction / collisions</p>	2

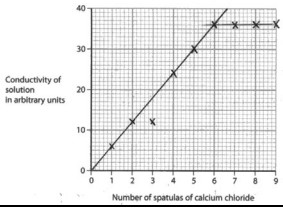
Question number	Answer	Notes	Marks
5 (a)	Results are the same at the end	<p>ALLOW there is a constant volume in the tube</p> <p>ALLOW the volume of gas stops decreasing</p> <p>ALLOW no change after 4 / 5 minutes</p> <p>IGNORE references to time</p> <p>REJECT the volume of gas stops increasing</p>	1
(b)	(use a glass tube / scale with) smaller divisions.	<p>ALLOW use a glass tube / scale with 0.1cm³ divisions</p> <p>ALLOW use a smaller scale</p> <p>IGNORE references to repeating the experiment</p> <p>IGNORE references to temperature</p>	1
(c)	<p>M1 Volume of oxygen = 11.5(cm³)</p> <p>M2 $(11.5 \div 48.5) \times 100$</p> <p>M3 23.7%</p>	<p>Correct answer to 1 dp with or without working scores 3</p> <p>ALLOW ecf from M1</p> <p>M3 must be to 1dp</p>	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 = $36.1(^{\circ}\text{C})$ M2 15 162J	Correct answer with or without working scores 2 ALLOW ecf from M1 ALLOW 2 or more significant figures IGNORE negative sign	2
(ii)	An explanation that links any two of the following points M1 polystyrene is an insulator M2 (so) reduces heat loss (to the surroundings) OWTTE M3 temperature rise/change/reading will be closer to true value OWTTE	ALLOW polystyrene is not a (good) conductor of heat ALLOW polystyrene is a poor conductor of heat ALLOW prevents heat loss ALLOW keeps heat in ALLOW temperature rise/change/reading will be more accurate/valid	2

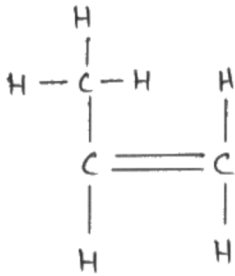
(c)(i)	<p>M1 calculate the amount, in moles, of zinc</p> <p>M2 divide Q by the amount in moles</p> <p>M3 give the answer to three significant figures with a - sign</p> <p>Example calculation</p> <p>M1 $0.500 \div 65$ OR 0.00769</p> <p>M2 $1.67 \div 0.00769$ OR 217 (kJ/mol)</p> <p>M3 -217 (kJ/mol)</p> <p>OR</p> <p>M1 $1.67 \div 0.5$ OR 3.34 kJ/g)</p> <p>M2 3.34×65 OR 217 (kJ/mol)</p> <p>M3 -217 (kJ/mol)</p>	<p>M2 subsumes M1</p> <p>Correct answer of -217 with or without working scores 3 marks.</p> <p>Allow ECF throughout</p>	3
(c)(ii)	<p>M1 zinc is oxidised and Cu^{2+} is reduced</p> <p>M2 Zinc loses electrons</p> <p>M3 Cu^{2+} gains electrons</p>	<p>ALLOW zinc is oxidised and copper(sulfate) is reduced in M1</p> <p>ALLOW oxidation and reduction occur</p> <p>ALLOW references to changes in oxidation number for M2 and M3</p> <p>Must mention copper ions for M3</p>	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)	<p>M1 the reaction is exothermic (therefore the temperature rises)</p> <p>M2 (after 25cm³ of sodium hydroxide) the reaction is complete OWTTE</p> <p>M3 so adding more sodium hydroxide / liquid / solution cools the mixture down</p>	<p>ALLOW the reaction gives out heat (energy) or thermal energy IGNORE energy alone</p> <p>ALLOW (after 25cm³ of sodium hydroxide) neutralisation happens</p> <p>ALLOW so no more heat (energy) or thermal energy is given out OWTTE IGNORE energy alone</p>	3

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

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

Question number	Answer	Notes	Marks
9 (a) (i)	<p>M1 (Empirical formula) CH₂</p> <p>M2 (General formula) C_nH_{2n}</p>	<p>ALLOW sub and super script numbers for M1 and M2</p> <p>ALLOW letters other than n</p> <p>ALLOW capital letters</p>	2
(ii)	<p>Any two from:</p> <p>M1 each member differs from the next by a CH₂ group OWTTE</p> <p>M2 (each member has) same functional group</p> <p>M3 (each member has) similar/same chemical properties / similar/same (chemical) reactions</p> <p>M4 trend in physical properties (between successive members)</p>	<p>ACCEPT react in similar/same way</p> <p>ACCEPT named physical property, e.g. boiling point</p> <p>REJECT similar/same physical properties</p>	2
(b) (i)	addition	<p>ALLOW additional</p> <p>REJECT condensation</p>	1
(ii)	<p>(ii) Complete the equation for the polymerisation of ethene. (2)</p> $n \begin{array}{c} \text{H} & & \text{H} \\ & \backslash & / \\ & \text{C} = \text{C} \\ & / & \backslash \\ \text{H} & & \text{H} \end{array} \rightarrow \left(\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n$ <p>M1 Single bond between the two carbons, 4 hydrogens joined by single bonds</p> <p>M2 trailing bonds through the brackets and the n to the right</p>	<p>ALLOW n in any position outside the bracket to the right of the structure.</p> <p>ALLOW capital N</p>	2
(iii)	<p>Any 5 points from:</p> <p>M1 Poly(ethene) is cheaper than polymers from corn starch</p> <p>M2 Poly(ethene) is stronger than polymers from corn starch</p> <p>M3 Poly(ethene) frees up land to grow food crops</p>	<p>If only advantages or disadvantages given, max 3 marks</p> <p>IGNORE durable</p>	5

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

Question number	Answer	Notes	Marks
10 (a) (i)	<p>M1 four electrons between the carbon and each oxygen</p> <p>M2 rest of molecule correct</p>	<p>M2 dep on M1</p>	2
(ii)	<p>M1 shared pair(s) of electrons</p> <p>M2 attracted to (two) nuclei</p>	<p>REJECT nucleus. Must be plural for M2. M2 dep on mention of electrons in M1</p>	2
(b) (i)	<p>M1 Graphite has delocalised electrons</p> <p>M2 (delocalised electron(s)) can move or flow (throughout the structure)</p>	<p>IGNORE sea of electrons IGNORE free electrons IGNORE number of electrons</p> <p>IGNORE references to carrying a charge or current IGNORE references to layers</p> <p>M2 dep on mentioning electrons in M1</p> <p>Any mention of ions scores 0</p>	2
(ii)	<p>M1 (diamond) giant covalent</p> <p>M2 (in melting diamond) covalent bonds are broken</p> <p>M3 (C₆₀) (simple) molecular structure</p> <p>M4 (in melting C₆₀) intermolecular forces (of attraction) are overcome</p> <p>M5 more energy is needed to break covalent bonds (in diamond) than intermolecular forces (in C₆₀)</p>	<p>ALLOW macromolecular ALLOW giant structure if M2 is scored IGNORE tetrahedral structure REJECT molecules of diamond</p> <p>ALLOW description of covalent bonds</p> <p>ALLOW molecules of C₆₀</p> <p>ALLOW strong covalent bonds and weak intermolecular forces (or attraction)</p>	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)	$4 \text{ CuO (s)} + \text{CH}_4 \text{ (g)} \rightarrow 4 \text{ Cu (s)} + \text{CO}_2 \text{ (g)} + 2 \text{ H}_2\text{O (l/g)}$ 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)	<ul style="list-style-type: none"> • 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 <p>Example calculation</p> <p>M1 M_r of $\text{Fe}_2\text{O}_3 = 160$</p> <p>M2 $n(\text{Fe}_2\text{O}_3) = 30.0 \times 10^6 \div 160$ OR 187,500 moles</p> <p>M3 $n(\text{Fe}) = 187,500 \times 2$ OR 375,000 moles</p> <p>M4 $375,000 \times 56 = 21$ tonnes</p>	<p>Correct answer of 21 tonnes scores 4 marks with or without working</p> <p>ALLOW ecf from M1 (incorrect M_r)</p> <p>ALLOW working in megamoles ALLOW ecf from M1</p> <p>ALLOW working in megamoles ALLOW ECF from M2</p> <p>ALLOW ecf from M3</p>	4
(iv)	<p>M1 840,000g is 70,000 moles of carbon</p> <p>M2 therefore need 23,333 moles Fe_2O_3 (but we have 25,000 which is an excess)</p> <p>OR</p> <p>M1 Need 75,000 moles carbon</p> <p>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)</p> <p>OR</p> <p>M1 need 75,000 moles of carbon</p> <p>M2 have $840,000 \div 12$ OR 70,000 moles of carbon (so iron(III) oxide is in excess as carbon is the limiting reactant)</p>		2

