Mark Scheme (Results)

January 2020

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

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

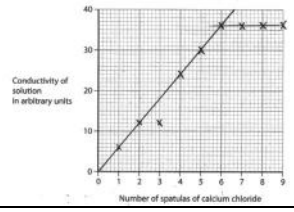
Question number	Answer	Notes	Marks
5 (a)	Results are the same at the end	**ALLOW** there is a constant volume in the tube **ALLOW** the volume of gas stops decreasing **ALLOW** no change after 4 / 5 minutes **IGNORE** references to time **REJECT** the volume of gas stops increasing	1
(b)	(use a glass 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

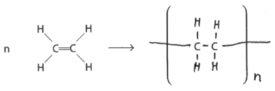
Question number	Answer	Notes	Marks
6 (a) (i)	magnesium is more reactive than copper	**ALLOW** magnesium can displace copper **ALLOW** magnesium is higher than copper in the reactivity series **REJECT** magnesium is more reactive than copper(II) **or** Cu^{2+} **or** copper sulfate	1
(ii)	magnesium sulfate + 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	

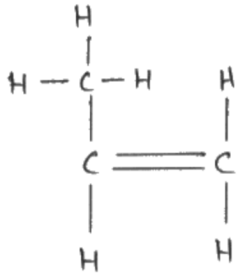
(c)(i)	**M1** calculate the amount, in moles, of zinc **M2** divide Q by the amount in moles **M3** give the answer to three significant figures with a - sign Example calculation **M1** 0.500 ÷ 65 **OR** 0.00769 **M2** 1.67 ÷ 0.00769 **OR** 217 (kJ/mol) **M3 -**217 (kJ/mol) **OR** **M1** 1.67 ÷ 0.5 **OR** 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)	(ii) Complete the equation for the polymerisation of ethene. (2)  **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