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Mark Scheme (Results)

November 2021

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1C and

Science (Double Award) (4SD0) Paper 1C

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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.

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Question number	Answer	Notes	Marks
1 (a) (i)	**A** A is the correct answer because A contains one element and the atoms are not joined to other atoms. B is incorrect because B contains molecules of an element. C is incorrect because C contains molecules of a compound D is incorrect. D contains an element but the atoms are joined together to form a giant covalent structure.		1
(ii)	**C** C is the correct answer because C contains atoms of two different elements chemically bonded together. A is incorrect because A is an element. B is incorrect because B is an element. D is incorrect because D is an element.		1
(iii)	**B** B is correct because B shows two atoms of the same element chemically bonded together e.g. H_2 A is incorrect because A contains atoms of an element C in incorrect because C contains molecules of a compound with the formula e.g. H_2O D is incorrect because C contains a giant covalent structure that could have the formula C		1
(b)	**M1** two different elements **M2** not (chemically) joined / (chemically) bonded together	**ALLOW** two different types of/sizes of atom.	2
			5

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Question number			Answer	Notes	Marks
2	(a)	(i)	fluorine has the fewest number of shells / energy levels	**ALLOW** fluorine has the fewest number of electrons **IGNORE** references to protons, neutrons, atomic number and mass number	1
		(ii)	**C** **C** is the correct answer because iodine is in period 5 therefore has 5 shells and group 7 therefore has 7 electrons in its outer shell. A is incorrect because arsenic has 5 shells and 4 electrons in its outer shell. B is incorrect because selenium has 4 shells and 6 electrons in its outer shell. D is incorrect because the number of shells and number of electrons in the outer shell in iodine have been reversed.		1
	(b)	(i)	**M1** does not need heating **M2** reacts very quickly	 must imply quicker reaction than chlorine	2
		(ii)	**M1** as the atoms get bigger **M2** the reactivity decreases	 **ACCEPT** reverse argument	2
					6

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Question number			Answer	Notes	Marks
3	(a)	(i)	oxygen	**IGNORE** air **ACCEPT** O_2	1
		(ii)	(hydrated) iron (III) oxide	**ALLOW** iron oxide /ferric oxide **REJECT** incorrect oxidation states of iron	1
	(b)	(i)	**M1** plastic acts as a barrier **M2** therefore stops oxygen / water getting to the iron	**ALLOW** forms a protective layer **ALLOW** air in place of oxygen	2
		(ii)	galvanising	**ALLOW** sacrificial protection **IGNORE** sacrificial method	1
		(iii)	**M1** zinc is more reactive than iron /higher in the reactivity series than iron **M2** therefore reacts / oxidises / corrodes in preference to iron	**IGNORE** references to rates of reaction **REJECT** references to zinc rusting	2
					7

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Question number	Answer	Notes	Marks
4 (a) (i)	14		1
(ii)	2.5	**REJECT** any charge shown **IGNORE** brackets	1
(iii)	**M1** same number of protons **M2** different numbers of neutrons	**IGNORE** references to numbers of electrons	2
(iv)	**M1** (three) more electrons than protons **M2** electrons have a negative charge and protons have a positive charge	**REJECT** incorrect numbers of electrons	2
(b)	**M1** (98.930 × 12) + (1.070 × 13) ÷ 100 **M2** 12.01	**ALLOW** 1 mark for 1201.07 if not divided by 100 as long as given to 2dp correct answer to 2 decimal places with or without working scores 2 marks.	2
			8

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Question number	Answer	Notes	Marks
5 (a)	Any one from: **M1** add more limewater (to cover tube on left) **M2** the glass tube on the left should be longer/in the limewater		1
(b) (i)	**M1** volume of carbon dioxide = 10 (cm^3) **M2** 10÷76 × 100 = 13.2 (%)	correct answer with or without working scores 2 marks. **ACCEPT** any number of significant figures except 1 **REJECT** incorrect rounding **ALLOW** ecf on incorrect volume of carbon dioxide **ALLOW** 66/76 x 100 = 86.8 for 1 mark	2
(ii)	limewater turns (from colourless to) cloudy or milky	**ALLOW** white precipitate	1
(iii)	**M1** the percentage/amount of carbon dioxide in the air is too small **M2** therefore the reading on the syringe would change by less than 1 cm^3	**ALLOW** there is 0.04% of carbon dioxide in the air **ALLOW** the change on the gas syringe would be too small **ALLOW** syringe not precise/accurate enough to measure small volume changes	2

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Question number	Answer	Notes	Marks
5 (c) (i)	copper(II) oxide	**ALLOW** copper oxide /CuO **REJECT** copper (I) oxide	1
(ii)	the powder has a greater surface area (than larger pieces of copper)	**ALLOW** the powder reacts more quickly (than larger pieces of copper)	1
(iii)	**M1** argon/it has a full outer shell of electrons **M2** therefore does not lose or gain (or share) electrons	**ALLOW** has eight outer shell electrons	2
			10

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Question number	Answer	Notes	Marks
6 (a) (i)	Y		1
(ii)	V		1
(iii)	W		1
(iv)	X		1
(v)	displayed formula of but-1-ene or methylpropene		1
(vi)	Any two from		2
	M1 same general formula	**ALLOW** same empirical formula	
	M2 similar chemical properties	**ALLOW** they react in a similar way/same chemical properties	
	M3 trend in physical properties	**ACCEPT** named physical property e.g. trend in boiling points	
	M4 each consecutive member differs by a CH_2 group		
(b) (i)	**M1** $\frac{38.7}{12}$ $\frac{9.7}{1}$ $\frac{51.6}{16}$	0 marks if upside down calculation or use of atomic numbers	2
	OR 3.225 9.7 3.225		
	M2 (divide by smallest) 1 3 1		
(ii)	**M1** Mr of CH_3O = 31	$C_2H_6O_2$ without working scores 2	2
	M2 (62 ÷ 31 = 2 so molecular formula is) $C_2H_6O_2$		
			11

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Question number	Answer	Notes	Marks
7 (a) (i)	$N_2 + O_2 \rightarrow 2NO$	**ALLOW** fractions and multiples **IGNORE** state symbols, even if incorrect	1
(ii)	the reaction has a high activation energy / E_a	**ACCEPT** to give the reactants enough energy to react **ACCEPT** a lot of energy is required to break the bonds in the reactants **ALLOW** nitrogen is unreactive	1
(iii)	acid rain	**ACCEPT** references to respiratory problems **ALLOW** a specific harmful effect of acid rain **ALLOW** references to smog **ALLOW** references to greenhouse gases / global warming / climate change **ALLOW** toxic	1
(b) (i)	**M1** catalyst provides an alternative reaction route/ pathway **M2** with lower activation energy		2
(ii)	**M1** particles / molecules are closer together **M2** therefore more collisions **M3** per unit time	**ACCEPT** more particles in a smaller volume /space more frequent collisions scores **M2** and **M3** any reference to increasing energy max = 1	3

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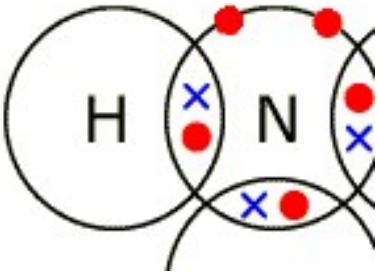
(c)	(i)	**M1** one pair of electrons between the nitrogen and each hydrogen		2
		M2 two non-bonding electrons on the nitrogen  	M2 dep on M1	2
	(ii)	**M1** (electrostatic) attraction between nuclei	nuclei must be plural	
		M2 and shared pair(s) of electrons	**ALLOW** bonding pair(s) of electrons	
		OR		2
		M1 (electrostatic) attraction between shared pair(s) of electrons	**ALLOW** bonding pair(s) of electrons	
		M2 and nuclei (of both atoms)	nuclei must be plural	
	(iii)	**M1** forces between molecules/intermolecular forces (of attraction) are weak	**ALLOW** intermolecular bonds are weak	
		M2 and therefore require little energy to overcome	**IGNORE** less energy Mention of breaking covalent bonds = 0	
				14

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Question number	Answer	Notes	Marks
8 (a)	Any six from: **M1** add barium carbonate (one spatula at a time) to the acid **M2** until the barium carbonate is in excess **M3** filter off the excess barium carbonate **M4** heat solution to evaporate some of the water **M5** cool or leave to crystallise **M6** filter the crystals (from the solution) **M7** leave crystals in a warm place to dry	 **ALLOW** until some barium carbonate is left/no longer effervesces /fizzes/bubbles **M3** dep on **M2** **ALLOW** heat until crystals start to form **ALLOW** heat until solution is saturated **ALLOW** heat until crystals form on the end of a glass rod/heat to crystallisation point **M6** dep on **M5** **IGNORE** washing **ALLOW** leave to dry **ALLOW** dry on filter paper **ALLOW** dry in a desiccator **ALLOW** dry in a (warm) oven If solution is evaporated to dryness **M5**, **M6** and **M7** cannot be scored	6
(b)	**M1** add (dilute) acid before adding the barium chloride **M2** white precipitate	**ALLOW** any named acid except sulfuric acid **M2** is dependent on **M1**	2
			8

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Question number	Answer	Notes	Marks
9 (a) (i)	**M1** and **M2** all points correctly plotted to the nearest half a square	deduct 1 mark for each error	2
(ii)	smooth curve of best fit		1
(iii)	An explanation that links any **two** of the following points **M1** polystyrene is an insulator **M2** reduces thermal energy/heat coming in from the surroundings OWTTE **M3** temperature decrease will be closer to true value OWTTE	 **ALLOW** results will be more accurate	2
(iv)	Any one from: **M1** the student recorded the temperature before adding the sodium carbonate /the temperature had not stopped decreasing OWTTE **M2** the student forgot to the stir the mixture	 **ALLOW** less than 0.5 g of/not enough sodium carbonate was added	1
(v)	(two) results at the end are the same	**ALLOW** the temperature stops decreasing	1
(vi)	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 temperature decrease (of the reaction mixture)	 **REJECT** exothermic for both marks **ALLOW** references to cooling No **M2** or **M3** if the statements contradict one another	2

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Question number	Answer	Notes	Marks
9 (b) (i)	to prevent acid / liquid / solution splashing out		1
(ii)	**M1** (M_r of sodium carbonate) = 106		3
	M2 (moles of sodium carbonate 2.12 ÷ 106 =) 0.02	**ALLOW** ecf from **M1** **M2** subsumes **M1**	
	M3 (mass of carbon dioxide 0.02 × 44 =) 0.88 (g)	**ALLOW** answer from **M2** x 44 answer of 0.88 (g) with or without working scores 3	
(iii)	Any one from: **M1** the sodium carbonate is impure **M2** some of the carbon dioxide dissolves in the acid/solution		1
			14

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Question number	Answer	Notes	Marks
10 (a) (i)	fractional distillation	**ALLOW** distillation **REJECT** simple distillation	1
(ii)	evaporation	**ALLOW** evaporating /boiling	1
(iii)	condensation	**ALLOW** condensing	1
(b) (i)	**M1** (mass ethanol 15.50 × 0.79 =) 12.245 (g) **M2** (moles ethanol = 12.245 ÷ 46 =) 0.266 (mol) **OR** **M1** (1 cm^3 ethanol = 0.79 ÷ 46 =) 0.0172 mol **M2** (15.5 cm^3 ethanol = 0.0172 × 15.5 =) 0.267 (mol)	 **ALLOW** any number of significant figures except 1 **ALLOW** ecf from **M1** **ALLOW** any number of significant figures except 1 **ALLOW** ecf from **M1** correct answer with or without working scores 2.	2
(ii)	answer from (b)(i) × 6 × 10^{23} e.g. (0.266 × 6.0 x 10^{23} =) 1.60 x 10^{23}	**ALLOW** any number of significant figures except 1 **ALLOW** answer in ordinary form	1

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Question number	Answer	Notes	Marks
10 (c) (i)	**M1** add anhydrous copper sulfate **M2** turns blue	**ALLOW** add white copper sulfate **M2** dependent on **M1** **ALLOW** **M1** add anhydrous cobalt chloride/ cobalt chloride paper **M2** turns pink **M2** dependent on **M1**	2
(ii)	**M1** measure boiling point **M2** is 100°C	**ALLOW** melting/freezing point is 0°C for both marks	2
10 (d) (i)	**M1** $\Delta T = 49.5^{\circ}C$ **M2** $Q = mc\Delta T$ **OR** $100 \times 4.2 \times 49.5$ **M3** 20 790 J	correct answer with or without working scores 3 **ALLOW** ecf from **M1** **ALLOW** 20 800	3
(ii)	**M1** 20.790 kJ **M2** (20.790 ÷ 0.0200 =) -1039.5 (kJ/mol)	**ALLOW** answer to 10(c)(i) ÷ 1 000 **ALLOW** any number of significant figures from 3 **ALLOW M1** ÷ 0.0200 as long as answer is negative. **REJECT** incorrect rounding. **REJECT** positive answer.	2
			15

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Question number	Answer	Notes	Marks
11 (a) (i)	displacement	**ALLOW** redox	1
(ii)	(manganese) chromium cadmium tin		1
(b)	(copper and magnesium sulfate) **M1** no colour change **M2** copper is less reactive than magnesium ORA /copper cannot displace magnesium (zinc and iron sulfate) **M3** zinc turns (from light grey to) dark grey **M4** solution turns (from green to) colourless **M5** zinc is more reactive than iron ORA/ zinc displaces iron	 **ALLOW** copper is below magnesium in the reactivity series ORA **IGNORE** copper and magnesium sulfate do not react **M2** dep on **M1** **ALLOW** zinc becomes coated in a dark grey metal **ALLOW** zinc is above iron in the reactivity series ORA **ALLOW** zinc reduces iron ions (ignore charge given as long as the charge is positive)	5
(c) (i)	Any two from **M1** concentration of dilute sulfuric acid **M2** temperature **M3** surface area of the metal	 **ALLOW** size of piece of metal	2
(ii)	calcium sulfate forms a layer / coating around the calcium metal	**ALLOW** calcium sulfate prevents the sulfuric acid coming into contact with calcium.	1

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(d)	**M1** (moles of aluminium =) 1÷27 **OR** 0.0370 moles **M2** (moles of sulfuric acid required = $\frac{0.0370 \times 3}{2}$ =) 0.0556 moles (and there is more moles of sulfuric acid) **OR** **M1** (moles of aluminium required =) 0.0400 **M2** (mass of aluminium required = 27 × 0.0400 =) 1.08 g (and there is less than 1.08 g)	**ALLOW** any number of significant figures except 1 **ALLOW** 0.0555 if candidate has used rounded value of 0.0370 moles	2
			12

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