



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.

Question number	Answer	Notes	Marks
1 (a) (i)	<p>A A is the correct answer because A contains one element and the atoms are not joined to other atoms.</p> <p>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.</p> <p>(ii) C C is the correct answer because C contains atoms of two different elements chemically bonded together.</p> <p>A is incorrect because A is an element. B is incorrect because B is an element. D is incorrect because D is an element.</p> <p>(iii) B B is correct because B shows two atoms of the same element chemically bonded together e.g. H₂</p> <p>A is incorrect because A contains atoms of an element C is incorrect because C contains molecules of a compound with the formula e.g. H₂O D is incorrect because C contains a giant covalent structure that could have the formula C</p>		<p>1</p> <p>1</p> <p>1</p>
(b)	<p>M1 two different elements</p> <p>M2 not (chemically) joined / (chemically) bonded together</p>	ALLOW two different types of/sizes of atom.	2
			5

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	1
(ii)	<p>C</p> <p>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.</p> <p>A is incorrect because arsenic has 5 shells and 4 electrons in its outer shell.</p> <p>B is incorrect because selenium has 4 shells and 6 electrons in its outer shell.</p> <p>D is incorrect because the number of shells and number of electrons in the outer shell in iodine have been reversed.</p>	IGNORE references to protons, neutrons, atomic number and mass number	1
(b) (i)	<p>M1 does not need heating</p> <p>M2 reacts very quickly</p>	must imply quicker reaction than chlorine	2
(ii)	<p>M1 as the atoms get bigger</p> <p>M2 the reactivity decreases</p>	ACCEPT reverse argument	2
			6

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

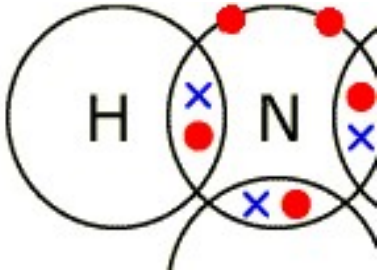
Question number	Answer	Notes	Marks
4 (a) (i)	14		1
(ii)	2.5	REJECT any charge shown IGNORE brackets	1
(iii)	M1 same number of protons M2 different numbers of neutrons	IGNORE references to numbers of electrons	2
(iv)	M1 (three) more electrons than protons M2 electrons have a negative charge and protons have a positive charge	REJECT incorrect numbers of electrons	2
(b)	M1 $(98.930 \times 12) + (1.070 \times 13) \div 100$ 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

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 $10 \div 76 \times 100 = 13.2$ (%)	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 $66/76 \times 100 = 86.8$ 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

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

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 M1 same general formula M2 similar chemical properties M3 trend in physical properties M4 each consecutive member differs by a CH ₂ group	ALLOW same empirical formula ALLOW they react in a similar way/same chemical properties ACCEPT named physical property e.g. trend in boiling points	2
(b) (i)	M1 $\frac{38.7}{12}$ $\frac{9.7}{1}$ $\frac{51.6}{16}$ OR 3.225 9.7 3.225 M2 (divide by smallest) 1 3 1	0 marks if upside down calculation or use of atomic numbers	2
(ii)	M1 Mr of CH ₃ O = 31 M2 (62 ÷ 31 = 2 so molecular formula is) C ₂ H ₆ O ₂	C ₂ H ₆ O ₂ without working scores 2	2
			11

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

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

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

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 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

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

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 $15.50 \times 0.79 =$) 12.245 (g) M2 (moles ethanol = $12.245 \div 46 =$) 0.266 (mol) OR M1 (1 cm^3 ethanol = $0.79 \div 46 =$) 0.0172 mol M2 (15.5 cm^3 ethanol = $0.0172 \times 15.5 =$) 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) $\times 6 \times 10^{23}$ e.g. ($0.266 \times 6.0 \times 10^{23} =$) 1.60×10^{23}	ALLOW any number of significant figures except 1 ALLOW answer in ordinary form	1

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 $\Delta T = 49.5^{\circ}\text{C}$ 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 $(20.790 \div 0.0200 =) -1039.5$ (kJ/mol)	ALLOW answer to 10(c)(i) $\div 1\ 000$ ALLOW any number of significant figures from 3 ALLOW M1 $\div 0.0200$ as long as answer is negative. REJECT incorrect rounding. REJECT positive answer.	2
			15

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

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

