



Mark Scheme (Results)

Summer 2022

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)	Atomic number of this atom 4 Mass number of this atom 9 Period number of this element 2 Number of electrons in the 2+ ion formed from this atom 2	1 mark each correct answer	4
(b)	Similarity = number of protons Difference = number of neutrons	ALLOW both isotopes have 4 protons ALLOW references to electrons ALLOW stated examples eg one isotope has 5 neutrons, the other has 6 neutrons If similarity: same atomic number and difference: different mass number ALLOW 1 mark	2

Total for question 1 = 6 marks

Question number	Answer		Notes	Marks
2 (a)	Apparatus	Unit	ALLOW ml ALLOW words e.g. grams ALLOW weighing machine ALLOW kg 1 mark each correct row/column Mark horizontally or vertically (whichever benefits the candidate)	2
	(gas) syringe	cm ³		
	(top pan) balance OR (weighing) scales	g OR mg		
(b) (i)	M1 to cool (the water vapour/steam) M2 so the water vapour/steam condenses		ALLOW to keep condenser cool ALLOW so the water vapour/steam becomes liquid	2
(ii)	M1 add silver nitrate/AgNO ₃ (solution) M2 white precipitate		IGNORE addition of nitric acid but REJECT addition of hydrochloric/sulfuric acid for M1 M2 dep on use of silver nitrate	2
(iii)	M1 measure its boiling point M2 (boiling point is) 100°C OR M1 measure its freezing point M2 (freezing point is) 0°C		ALLOW boil it ALLOW freeze it	2

Total for question 2 = 8 marks

Question number	Answer	Notes	Marks
3 (a) (i)	B		1
(ii)	A and B		1
(iii)	M1 2 and 8 M2 0.25	0.25 without working scores 2 ALLOW M1 for 1.8-2.2 and 8 and ALLOW M2 ECF as long as correctly evaluated to at least 2 SF (Special case if used ruler and then) 1.4-1.7 and 5.9-6.2 used no M1 but ALLOW M2 ECF as long as correctly evaluated to at least 2 SF	2
(iv)	the dye is the most soluble (in the solvent/water)		1
(b)	Any four from M1 draw start line in pencil M2 use same food colourings/use same solvent/use same (type of chromatography) paper M3 place (spots/samples of) A, B, C, D/food colourings on the start line OWTTE M4 (place paper in beaker) with start line above solvent OWTTE M5 (remove paper/stop experiment) when solvent almost reaches top of paper / when spots stop moving OWTTE M6 mark solvent front (on paper) M7 (remove paper from beaker and) allow to dry	ALLOW water for solvent throughout ALLOW dye for food colouring throughout IGNORE length of paper	4

Total for question 3 = 9 marks

Question number	Answer	Notes	Marks
4 (a)	(i) Any one from: Na K Al In	ALLOW names of elements Apply list principle	1
	(ii) Any one from S Cl	ALLOW names of elements	1
(b)	same number / three electrons in the outer shell	ALLOW valence shell	1
(c)	M1 Xe or xenon M2 as it has a full outer shell (of electrons)	ALLOW has eight electrons in outer shell ACCEPT does not (easily) gain/lose/share electrons M2 dep on M1	2
(d)	(i) M1 (universal indicator turns) blue or purple M2 because an alkali is produced	ACCEPT OH ⁻ / hydroxide ions are produced ALLOW sodium hydroxide is a base / a base is produced ALLOW fizzes/bubbles ALLOW float ALLOW both disappear/get smaller/dissolve ALLOW faster/more vigorous reaction for potassium ALLOW reverse arguments for sodium correct answer with no working scores 3 marks ALLOW ECF M1 × 6.0×10 ²³ ALLOW ECF M2 but must be to 2 sig figs 2.16 × 10 ²² scores 1 2.2 × 10 ²² scores 2	2
	(ii) (similarity) any one from: (both) effervesce melt / turn into a sphere move on surface universal indicator turns the same colour (difference) any one from: potassium gives a lilac flame potassium moves faster potassium effervesces faster		2
	(iii) Example calculation M1 (moles of hydrogen) 0.036÷2 OR 0.018 mol M2 0.018 × 6.0×10 ²³ OR 1.08×10 ²² molecules M3 1.1×10 ²²		3

Total for question 4 = 12 marks

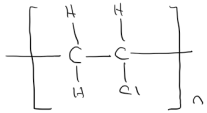
Question number	Answer	Notes	Marks
5 (a)	<p>M1 (put the carbonate in the boiling tube) and the limewater in the test tube</p> <p>M2 heat the carbonate and time how long it takes for the limewater to turn cloudy OWTTE</p> <p>M3 repeat with the same mass / amount / number of moles of another carbonate</p> <p>M4 (the carbonate which decomposes the fastest) will turn the limewater cloudy in the least time</p>	<p>ACCEPT repeat with another carbonate using same volume of limewater OWTTE</p> <p>To score M4 reference to limewater turning cloudy must be mentioned at least once somewhere in answer</p>	4
(b) (i)	to prevent loss of solid/ XCO_3 /carbonate/XO	ALLOW so <u>only</u> carbon dioxide/gas can escape	1
(ii)	0.05		1
(iii)	0.05	ALLOW ECF from (ii)	1
(iv)	<p>M1 $7.40 \div 0.05$</p> <p>M2 148</p>	<p>correct answer with or without working scores 2</p> <p>ALLOW ECF from (iii)</p>	2
(v)	<p>M1 A_r of metal = 148-60 OR 88</p> <p>M2 metal is strontium / Sr</p>	<p>If (iv) correct strontium/Sr scores 2 without working</p> <p>ALLOW ECF from (iv)</p> <p>ALLOW ECF from M1 as long as answer is nearest Group 2 metal</p>	2

Total for question 5 = 11 marks

Question number	Answer	Notes	Marks
6 (a)	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)	a pair of electrons in each bond and no non-bonding electrons.	ALLOW dots, crosses or any combination	1
(c) (i)	Any one from M1 oxygen is a smaller atom/particle than silicon M2 each (atom of) oxygen forms two bonds (to silicon atoms)		1
(ii)	M1 silicon dioxide has a giant (covalent) structure M2 (in melting silicon dioxide) strong/many covalent bonds (need to be broken) M3 (in melting silicon hydride) weak intermolecular forces (of attraction need to be overcome/broken) M4 more (thermal/heat) energy is needed to break the (covalent) bonds (in SiO ₂) than break/overcome the intermolecular forces (in SiH ₄)	ALLOW description of covalent bonds as long as strong/many mentioned ALLOW weak intermolecular bonds Max 2 if contradictions/references to incorrect forces/particles	4
(d)	SiH ₄ + 2O ₂ → SiO ₂ + 2H ₂ O all formula correct and equation correctly balanced	IGNORE state symbols ALLOW multiples and fractions	1

Total for question 6 = 9 marks

Question number	Answer	Notes	Marks
7 (a)	<p>Any five from</p> <p>M1 fractional distillation</p> <p>M2 crude oil heated/vapourised</p> <p>M3 reference to (fractionating) column/tower</p> <p>M4 which is hotter at the bottom than at the top</p> <p>M5 shorter hydrocarbons/chains/molecules have lower boiling point (and rise higher/towards the top)</p> <p>M6 fractions/hydrocarbons/gases/vapours/kerosene condense(s) at (levels depending on) their boiling points OWTTE</p>	<p>ALLOW boiled</p> <p>ALLOW reference to temperature gradient</p> <p>ALLOW the hydrocarbons/gases/vapours cool as they rise up the column</p> <p>ACCEPT reverse argument</p> <p>ALLOW correct reference to position of kerosene fraction below refinery gases and gasoline fractions or above diesel and fuel oil fractions</p>	5
(b) (i)	C_8H_{18}		1
(ii)	<p>Any four from</p> <p>M1 fractional distillation/crude oil produces more long-chain hydrocarbons than can be used (directly)</p> <p>M2 cracking produces short chain alkanes</p> <p>M3 short chain alkanes/hydrocarbons are more flammable/can be used as fuels</p> <p>M4 cracking produces alkene(s)</p> <p>M5 alkenes can be used to make polymers</p>	<p>ALLOW short(er) chain hydrocarbons are in higher demand/more useful than long(er) chain hydrocarbons ORA</p> <p>ALLOW cracking changes long(er) chain hydrocarbons into short(er) chain hydrocarbons</p> <p>IGNORE named alkene</p> <p>ALLOW named alkene forming (named) polymer e.g. ethene can be used to make poly(ethene)/polymer</p>	4

(c)	<p>A Addition The only correct answer is A because the reaction between an alkene and a halogen forming a halogenoalkane is addition. B is not the correct answer since this reaction is not combustion. C is not the correct answer since this reaction is not decomposition. D is not the correct answer since this reaction is not substitution.</p>		1
(d) (i)	 <p>M1 single bond between the two carbons and single bonds to three hydrogens and one chlorine</p> <p>M2 two extension bonds and n</p>	<p>n can be anywhere after brackets extension bonds do not have to go through brackets M2 dep on M1</p>	2
(ii)	<p>M1 they are inert/unreactive</p> <p>M2 (so) they are non-biodegradable/ do not (naturally) break down/decompose (in landfill sites)</p> <p>OR</p> <p>M1 when burned</p> <p>M2 they produce toxic fumes</p>	<p>ALLOW take long time to break down (so landfill sites may fill up)</p>	2

Total for question 7 = 15 marks

Question number	Answer	Notes	Marks
9 (a) (i)	M1 copper(II) sulfate (solution) M2 shortest time taken to turn colourless	ALLOW copper sulfate ALLOW gave greatest increase in rate OWTTE ALLOW made reaction happen fastest OWTTE M2 dep on M1	2
(ii)	M1 a catalyst provides an alternative pathway M2 of lower activation energy	 Any reference to increasing energy/speed of particles scores 0	2
(b) (i)	An explanation with following four points M1 the rate of reaction increases/ the reaction is faster/ the reaction speeds up M2 because the particles gain (kinetic) energy / move faster M3 there are more collisions per unit time M4 more of the collisions are successful / more collisions/particles have energy greater than the activation energy	 ACCEPT more frequent collisions OWTTE No M4 if refer to lower activation energy there are more frequent successful collisions scores M3 and M4	4
(ii)	M1 fewer particles per unit volume M2 (hence) fewer collisions per unit time	ALLOW particles less tightly packed / particles further apart ALLOW decrease in the frequency of collisions between particles Any reference to changing energy/speed of particles scores 0	2

Total for question 9 = 10 marks

Question number	Answer	Notes	Marks
10 (a) (i)	measuring cylinder / burette / pipette	ALLOW syringe	1
(ii)	M1 and M2 all the points correct $\pm$ half a square	If only one plotting error scores M1	2
(iii)	2 straight lines of best fit, ignoring the anomalous point	Left line does not have to go through/use (0.0, 10.0) if point has not been plotted	1
(iv)	as the volume of sulfuric acid increases the (electrical) conductivity decreases	IGNORE references to gradient/slope/correlation	1
(v)	(the student) forgot to stir the mixture	ALLOW any reference to adding less acid/lower volume (than should have done) OWTTE	1
(b) (i)	M1 barium sulfate has a (giant) ionic structure OR has ionic bonding M2 ionic substances do not conduct when solid M3 water has covalent bonding and covalent compounds do not (usually) conduct electricity	ALLOW only conduct when dissolved/molten ALLOW in solid ions cannot move ALLOW water does not conduct because it is covalent IGNORE explanations of why covalent do not conduct	3
(ii)	filtration OR filtering		1

Total for question 10 = 10 marks

Question number	Answer	Notes	Marks
11 (a) (i)	M1 $\text{WO}_3(\text{s}) + 3\text{H}_2(\text{g})$ M2 $\text{W}(\text{s}) + 3\text{H}_2\text{O}(\text{g or l})$	ALLOW upper case	2
(ii)	heat again to constant mass OWTTE		1
(iii)	M1 (mass of tungsten =) 1.84g AND (mass of oxygen =) 0.48g M2 (moles of tungsten) = $\frac{1.84}{184}$ or 0.01 AND (moles of oxygen) = $\frac{0.48}{16}$ or 0.03 M3 therefore ratio is 1:3	M2 subsumes M1 ALLOW M2 ECF from incorrect masses M3 dep on M2 ALLOW ECF from incorrect M2 only if does give 1:3 when rounded	3
(iv)	Any one from M1 use a safety screen M2 position the class some distance from the apparatus OWTTE M3 do the experiment in a fume cupboard	ALLOW heat proof/safety gloves ALLOW tie back hair	1
(b)	Example calculation M1 moles of tungsten oxide = $(2784 \times 10^6 \div 232) = 12\,000\,000$ M2 maximum mass of tungsten = $(12\,000\,000 \times 184) = 2\,208\,000\,000 \text{ g OR } 2208 \text{ tonnes}$ M3 mass of tungsten (considering 73.5% yield) = $(73.5 \times 2208 \div 100) = 1622.88 \text{ (tonnes)}$	correct answer without working scores 3 ALLOW any number of significant figures ≥ 2 throughout ALLOW other correct methods ALLOW working in megamoles ALLOW ECF M1 $\times$ 184 ALLOW ECF from M2	3

Total for question 11 = 10 marks

