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)	<table><tr><th>Apparatus</th><th>Unit</th></tr><tr><td>(gas) syringe</td><td>cm^3</td></tr><tr><td>(top pan) balance **OR** (weighing) scales</td><td>g **OR** mg</td></tr></table>	**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
(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	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	 **ALLOW** fizzes/bubbles **ALLOW** float **ALLOW** both disappear/get smaller/dissolve **ALLOW** faster/more vigorous reaction for potassium **ALLOW** reverse arguments for sodium	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}	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	3

Total for question 4 = 12 marks

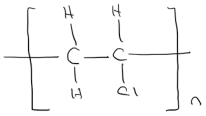
Question number	Answer	Notes	Marks
5 (a)	M1 (put the carbonate in the boiling tube) and the limewater in the test tube M2 heat the carbonate and time how long it takes for the limewater to turn cloudy OWTTE M3 repeat with the same mass / amount / number of moles of another carbonate M4 (the carbonate which decomposes the fastest) will turn the limewater cloudy in the least time	 **ACCEPT** repeat with another carbonate using same volume of limewater OWTTE To score M4 reference to limewater turning cloudy must be mentioned at least once somewhere in answer	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)	M1 7.40 ÷ 0.05 M2 148	correct answer with or without working scores 2 **ALLOW** ECF from (iii)	2
(v)	M1 A_r of metal = 148-60 **OR** 88 M2 metal is strontium / Sr	If (iv) correct strontium/Sr scores 2 without working **ALLOW** ECF from (iv) **ALLOW** ECF from M1 as long as answer is nearest Group 2 metal	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)	$SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$ 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)	Any five from		5
	M1 fractional distillation		
	M2 crude oil heated/vapourised	**ALLOW** boiled	
	M3 reference to (fractionating) column/tower		
	M4 which is hotter at the bottom than at the top	**ALLOW** reference to temperature gradient **ALLOW** the hydrocarbons/gases/vapours cool as they rise up the column	
	M5 shorter hydrocarbons/chains/molecules have lower boiling point (and rise higher/towards the top)	**ACCEPT** reverse argument	
	M6 fractions/hydrocarbons/gases/vapours/kerosene condense(s) at (levels depending on) their boiling points OWTTE	**ALLOW** correct reference to position of kerosene fraction below refinery gases and gasoline fractions or above diesel and fuel oil fractions	
(b) (i)	C_8H_{18}		1
(ii)	Any four from		4
	M1 fractional distillation/crude oil produces more long-chain hydrocarbons than can be used (directly)	**ALLOW** short(er) chain hydrocarbons are in higher demand/more useful than long(er) chain hydrocarbons ORA	
	M2 cracking produces short chain alkanes	**ALLOW** cracking changes long(er) chain hydrocarbons into short(er) chain hydrocarbons	
	M3 short chain alkanes/hydrocarbons are more flammable/can be used as fuels		
	M4 cracking produces alkene(s)	**IGNORE** named alkene	
	M5 alkenes can be used to make polymers	**ALLOW** named alkene forming (named) polymer e.g. ethene can be used to make poly(ethene)/polymer	

(c)	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.		1
(d) (i)	 M1 single bond between the two carbons **and** single bonds to three hydrogens and one chlorine M2 two extension bonds and n	n can be anywhere after brackets extension bonds do not have to go through brackets M2 dep on M1	2
(ii)	M1 they are inert/unreactive M2 (so) they are non-biodegradable/ do not (naturally) break down/decompose (in landfill sites) OR M1 when burned M2 they produce toxic fumes	**ALLOW** take long time to break down (so landfill sites may fill up)	2

Total for question 7 = 15 marks

Question number	Answer	Notes	Marks
8 (a) (i)	zinc + copper(II) sulfate → **zinc sulfate + copper**	**REJECT** copper(II) as a product **ACCEPT** zinc(II) sulfate	1
(ii)	polystyrene is an insulator / prevents heat loss	**ALLOW** to prevent the cup falling over	1
(iii)	zinc is more reactive / higher in the reactivity series than copper	**ALLOW** reverse argument	1
(iv)	M1 temperature rise = 28.6°C M2 (75 × 4.2 × 28.6 =) 9009	correct answer without working scores 2 ALLOW 9010/9000 **IGNORE** any sign **ALLOW** ECF from M1	2
(b) (i)	M1 800÷1000 OR 0.8 (kJ) M2 0.65÷65 OR 0.01 (mol) M3 0.8÷0.01 = −80 (kJ/mol) OR M1 0.65÷65 OR 0.01 (mol) M2 800÷0.01 OR 80 000 (J/mol) M3 −80 (kJ/mol)	correct answer without working scores 3 **ALLOW** ECF but answer must have a − sign 80/+80 scores 2	3
(ii)	M1 zinc/Zn is oxidised because loses electrons M2 silver ion(s)/Ag^+ reduced because gain electrons OR M1 zinc/Zn is oxidised **and** silver ion(s)/Ag^+ reduced M2 zinc/Zn loses electrons **and** silver ion(s)/Ag^+ gain electrons		2

Total for question 8 = 10 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 ± 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		3
	M2 ionic substances do not conduct when solid	**ALLOW** only conduct when dissolved/molten **ALLOW** in solid ions cannot move	
	M3 water has covalent bonding **and** covalent compounds do not (usually) conduct electricity	**ALLOW** water does not conduct because it is covalent **IGNORE** explanations of why covalent do not conduct	
(ii)	filtration **OR** filtering		1

Total for question 10 = 10 marks

Question number	Answer	Notes	Marks
11 (a) (i)	M1 $WO_3(s) + 3H_2(g)$	**ALLOW** upper case	2
	M2 $W(s) + 3H_2O(g \text{ or } l)$		
(ii)	heat again to constant mass OWTTE		1
(iii)	M1 (mass of tungsten =) 1.84g		3
	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	M2 subsumes M1 **ALLOW** M2 ECF from incorrect masses	
	M3 therefore ratio is 1:3	M3 dep on M2 **ALLOW** ECF from incorrect M2 only if does give 1:3 when rounded	
(iv)	Any one from		1
	M1 **u**se a safety screen	**ALLOW** heat proof/safety gloves	
	M2 **p**osition the class some distance from the apparatus OWTTE	**ALLOW** tie back hair	
	M3 **d**o the experiment in a fume cupboard		
(b)	Example calculation	correct answer without working scores 3 **ALLOW** any number of significant figures ≥2 throughout	3
	M1 moles of tungsten oxide = $(2784 \times 10^6 \div 232) =$ 12 000 000	**ALLOW** other correct methods **ALLOW** working in megamoles	
	M2 maximum mass of tungsten = (12 000 000 × 184)		
	= 2208000000 g **OR** 2208 tonnes	**ALLOW** ECF M1×184	
	M3 mass of tungsten (considering 73.5% yield) =		
	(73.5 × 2208 ÷ 100) = 1622.88 (tonnes)	**ALLOW** ECF from M2	

Total for question 11 = 10 marks

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