Mark Scheme (Results)

January 2021

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 1CR and Science (Double Award) (4SD0) Paper 1CR

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General Marking Guidance

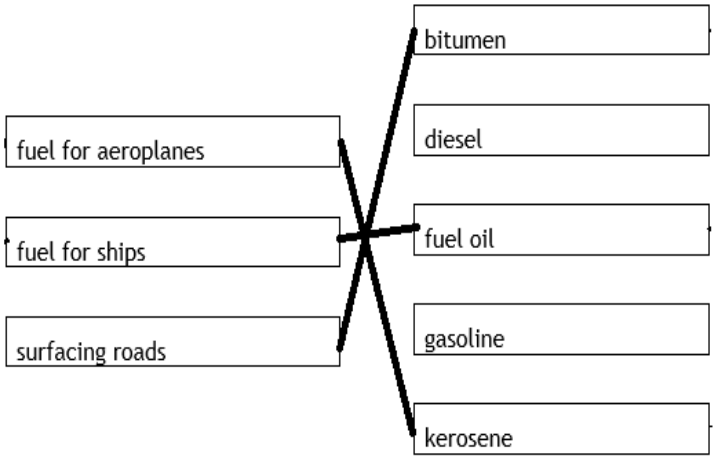
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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)	copper		1
	(b)	glucose/water		1
	(c)	air		1
	(d)	nitrogen/oxygen		1
	(e)	copper		1
	(f)	oxygen and sulfur	in either order	1

(Total for Question 1 = 6)

Question number	Answer	Notes	Marks
2 (a)	Any two from the following: M1 contains 3 dyes M2 contains (dye) A M3 contains (dye) B M4 does not contain (dye) C / contains an unknown dye OWTTE		2
(b) (i)	(Ink 2) is insoluble (in solvent/water)	ALLOW does not contain (dye) A/B/C	1
(ii)	(repeat) using different solvent	ALLOW named alternative solvent eg alcohol/ethanol	1
(c)	M1 correct measurement of distance moved by spot AND correct measurement of distance moved by solvent M2 use and evaluation of R_f = distance moved by spot / distance moved by solvent front M3 answer to 2 sig fig	ALLOW 5.4-5.6 ALLOW 7.9-8.1 Expected: 5.5 / 8.0 = 0.6875 = 0.69 ALLOW ECF from M1 M2 correct answer with no working scores 3	3

(Total for Question 2 = 7)

Question number	Answer	Notes	Marks
3 (a)	alkanes		1
(b) (i)	**A** boiling point is the correct answer because fractional distillation depends on differences in boiling point **B** is not correct because fractional distillation does not depend on differences in density **C** is not correct because fractional distillation does not depend on differences in melting point **D** is not correct because fractional distillation does not depend on differences in solubility		1
(b) (ii)	 1 mark for each correct line from boxes on left	If more than one line from a box on left do not award mark for that box	3
(c)	explanation including the following points: M1 (common impurity in fuels is) sulfur M2 sulfur burns/combusts/reacts (in air/oxygen) to form sulfur dioxide/SO_2 M3 sulfur dioxide/SO_2 dissolves in/reacts with rain/water to form acid rain	If M2 M3 not scored ALLOW 1 mark for reference to sulphur dioxide/SO_2 and acid rain	3

Question number	Answer	Notes	Marks
3 (d) (i)	cracking		1
(ii)	M1 (catalyst) silica/alumina	ALLOW silicon dioxide/aluminium oxide ALLOW formulae	2
	M2 (temperature) 600-700 (°C)	ALLOW zeolite	
(iii)	$C_{13}H_{28} \rightarrow C_8H_{18}$ +		
	M1 C_3H_6 +	in either order ALLOW structural formulae	2
	M2 C_2H_4		
		ALLOW 1 mark for single product C_5H_{10}	

(Total for Question 3 = 13)

Question number	Answer	Notes	Marks
4 (a) (i)	(hydrated) iron(III) oxide	REJECT incorrect oxidation states	1
(ii)	M1 (barrier method involves) coating iron in paint/oil/grease/plastic M2 stops oxygen/air/water getting to the iron	ALLOW coating in named metal below iron in reactivity series eg tin ALLOW stops iron reacting with oxygen/air/water	2
(b) (i)	<table><tr><td>reading at start</td><td>20.5</td></tr><tr><td>reading at end</td><td>33.5 (1)</td></tr><tr><td>volume of oxygen used in cm^3</td><td>13.0 (1)</td></tr></table>	CSQ on reading	2
(ii)	not all oxygen had reacted / not enough iron (wool)	ALLOW not left for long enough/ OWTTE	1
(c)	M1 calculation of volume oxygen used M2 correct expression for percentage of oxygen M3 correct evaluation Example calculation: M1 (35.5 – 20.0 =) 15.5 M2 (15.5 ÷ 80.0) x 100 M3 19.4(%)	 ALLOW ECF from M1 ACCEPT 19.375/19.38 correct answer with no working scores 3	3

(Total for Question 4 = 9)

Question number	Answer	Notes	Marks
5 (a)	(thermal) decomposition (1)		1
(b)	any two of the following:		2
	M1 (use the same) amount of metal carbonate	ALLOW mass	
	M2 (use the same) sized pieces/surface area		
	M3 (use the same) volume of limewater	ALLOW amount	
	M4 (use same) size flame / distance of flame from boiling tube OWTTE		
(c)	bubbles are air (from tube) / caused by air (expanding on heating)	ALLOW gas in tube expands (on heating)	1
(d)	explanation including		2
	M1 (when limewater turns milky/cloudy it) shows carbon dioxide produced		
	M2 showing metal carbonate has reacted/decomposed	ALLOW carbon dioxide comes from carbonate (reacting/decomposing)	
(e) (i)	M1 (from) green	IGNORE qualifiers eg light	2
	M2 (to) black		
(ii)	$CuCO_3 \rightarrow CuO + CO_2$	ALLOW products in either order	1

Question number	Answer	Notes	Marks
5 (f) (i)	M1 the lower the metal is (in the reactivity series) M2 the more easily the (metal) carbonate reacts/decomposes	ALLOW the less reactive a metal is ALLOW the more easily the (metal) carbonate produces carbon dioxide ALLOW references to the less time the (metal) carbonate takes to react/decompose ALLOW references to the faster the (metal) carbonate reacts/decomposes ACCEPT reverse arguments	2
(ii)	repeat (the investigation) using different / other / more (metal) carbonates		1

(Total for Question 5 = 12)

Question number	Answer	Notes	Marks
6 (a) (i)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ M1 all symbols and formulae correct M2 correctly balanced	 M2 DEP M1	2
(ii)	lighted splint (produces squeaky) pop		1
(b) (i)	52 (cm^3)	ALLOW 51.5-52.5	1
(ii)	M1 vertical line from 15 cm^3 acid to graph line M2 volume hydrogen from graph multiplied by 2 OR M1 vertical line from 30 cm^3 acid to graph line M2 volume hydrogen from graph	ALLOW extra point drawn at 15 cm^3 ALLOW 68-70 ALLOW extra point drawn at 30 cm^3 ALLOW 68-70	2
(c)	explanation linking M1 more (acid) particles/(hydrogen) ions/H^+ in same volume M2 more (successful) collisions per second/unit time M3 rate increases	 REJECT molecules once only ALLOW particles are closer together ACCEPT more frequent collisions IGNORE more chance/probability of collision ALLOW reaction is faster /speeds up MAX 1 if refer to particles moving faster/having more energy	3

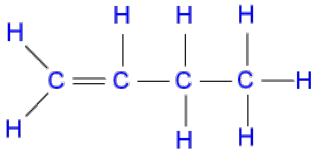
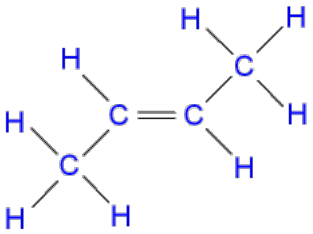
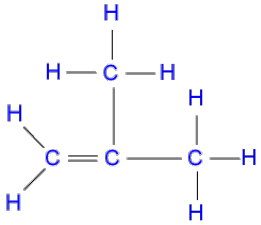
6 (d)	explanation including M1 (increase/decrease) surface area M2 increase surface area by using smaller pieces of zinc M3 more (successful) collisions per second/unit time (so rate increases)	 ACCEPT more frequent collisions IGNORE more chance/probability of collision M2 M3 ACCEPT reverse arguments	3

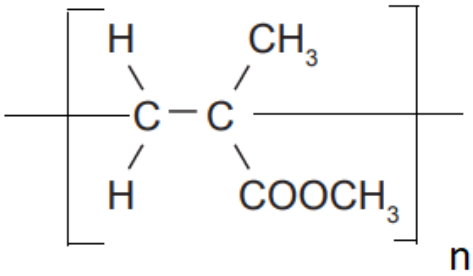
(Total for Question 6 = 12)

Question number	Answer	Notes	Marks
7 (a)	description including (formation of ions in lithium chloride involves) M1 lithium (atom) losing electron M2 chlorine (atom) gaining an electron (formation of covalent bonds in hydrogen chloride involves) M3 sharing a pair of electrons (one electron from each atom)	 ALLOW correct dot-and-cross diagrams for ions for M1 and M2 ALLOW correct dot-and-cross diagram showing shared pair in hydrogen chloride for M3	3

7 (b)	explanation including five of the following points: (lithium chloride) M1 giant (ionic) structure M2 strong (electrostatic) forces of attraction M3 between oppositely charged ions (hydrogen chloride) M4 simple molecular structure M5 weak intermolecular forces of attraction M6 more (heat/thermal) energy needed to overcome forces/break bonds in lithium chloride (than intermolecular forces in hydrogen chloride) OWTTE	 ALLOW giant lattice ALLOW strong bonds ACCEPT positive and negative ions If any reference to molecules/atoms/covalent bonds/intermolecular forces/metallic bonds cannot score M2 M3 M6 ALLOW weak bonds between molecules ACCEPT reverse argument If description/implication of breaking covalent bonds in hydrogen chloride cannot score M5 M6	5

(Total for Question 7 = 8)

Question number	Answer	Notes	Marks
8 (a) (i)	explanation linking M1 (molecules/compounds) having same molecular formulae M2 but different structural/displayed formulae	 ALLOW different structures ALLOW different arrangement of atoms	2
(ii)	M1 displayed formula of but-1-ene  M2 displayed formula of but-2-ene 	IGNORE bond angles ALLOW displayed formula of methylpropene 	2

Question number	Answer	Notes	Marks
8 (b) (i)	explanation linking M1 molecule is unsaturated as contains (carbon to carbon) double bond M2 molecule not a hydrocarbon as contains oxygen	 ACCEPT does not contain hydrogen and carbon only	 2
(ii)	addition		1
(iii)	 M1 correct repeat unit structure M2 extension bonds, brackets and n	 n can be anywhere after bracket extension bonds do not have to go through brackets M2 DEP M1 or near miss	2

Question number	Answer	Notes	Marks
8 (c) (i)	M1 calculation of mass of octane M2 calculation of Mr of C_8H_{18} and CO_2 M3 link between mass/mol C_8H_{18} and mass/mol CO_2 M4 calculation of mass CO_2 in g M5 calculation of mass CO_2 in kg Example calculation: M1 50 x 700 = 35000 (g) M2 M_r of C_8H_{18} = 114 and M_r CO_2 = 44 M3 114g C_8H_{18} produces (8 x 44 =) 352 (g) CO_2 M4 35000 g C_8H_{18} produces $\frac{35000 \times 352}{114}$ = 108070.2 (g) CO_2 M5 = 108 (kg) Alternative method using mol: M1 50 x 700 = 35000 (g) M2 M_r of C_8H_{18} = 114 and Mr CO_2 = 44 M3 n (C_8H_{18}) = $\frac{35000}{114}$ = 307.0175 mol so n (CO_2) = 8 x 307.0175 = 2456.14 mol M4 mass CO_2 = 2456.14 x 44 = 108070.2 (g) M5 = 108 (kg)	ALLOW 2 sig fig or more in M4 and M5 ALLOW 2 sig fig or more in M3 M4 and M5 MARK CSQ in both methods correct answer without working scores 5	5

(ii)	global warming/climate change	IGNORE greenhouse effect	1

(Total for Question 8 = 15)

Question number	Answer	Notes	Marks
9 (a)	to keep out of contact/prevent reaction with air/oxygen/water/moisture	ALLOW they react with air/oxygen/water/moisture	1
(b) (i)	similarity: both fizz/move on surface/ produce flame	ALLOW both melt/form a ball/produce a gas/ produce hydrogen/form an alkaline solution	2
	difference caesium: faster/more violent reaction	ACCEPT reverse argument for potassium ALLOW caesium explodes	
(ii)	$2Cs + 2H_2O \rightarrow 2CsOH + H_2$ M1 all symbols/formulae correct M2 correctly balanced	ACCEPT fractions and multiples M2 DEP M1	2
(c) (i)	a lid/cover		1
(ii)	explanation linking either M1 stir solution M2 to obtain more accurate (maximum) temperature OR M1 measure temperature of sodium hydroxide M2 to check if different to/same as temperature of (hydrochloric) acid	ALLOW reference to even temperature throughout/ heat evenly distributed OWTTE ALLOW take an average of temperature of sodium hydroxide and temperature of (hydrochloric) acid for 2 marks	2

Question number	Answer	Notes	Marks
9 (d) (i)	M1 correct temperature change/△T M2 correct substitution into Q = m x c x △T M3 correct evaluation Example calculation: M1 △T = (26.5 – 19.9) OR 6.6 M2 Q = 100 x 4.2 x 6.6 M3 = 2800 (J)	 M2 ECF M1 M3 ECF M2 IGNORE any sign ALLOW 2770, 2772 correct answer without working scores 3	3
(ii)	M1 answer to M3 from (i) ÷ 0.05 M2 correct evaluation in kJ/mol with negative sign expected answer M1 2800 ÷ 0.05 OR 56000 (J) M2 - 56 (kJ/mol)	 2770 gives 55400 2772 gives 55440 negative sign required ACCEPT -55.4 ACCEPT -55.44 ACCEPT -55 correct answer without working scores 2	2

(Total for Question 9 = 13)

Question number	Answer	Notes	Marks
10 (a) (i)	neutralisation	ALLOW acid - base	1
(ii)	acid donates proton(s)/base accepts proton(s)	ALLOW metal oxide for base	1
(b) (i)	description including M1 appropriate use of at least three named pieces of apparatus AND any four of the following points M2 add copper(II) carbonate to (dilute sulfuric) acid (a spatula/little at a time and stir after each addition) M3 until no more effervescence M4 filter (to remove excess copper(II) carbonate/to obtain (copper(II) sulfate) solution) M5 heat/warm filtrate/(copper(II) sulfate) solution until crystals start to appear (solution saturated) OWTTE M6 filter to obtain (the saturated) solution	ALLOW until no more reacts/dissolves ALLOW until in excess IGNORE if continue and prepare crystals instead of saturated solution	5
(b) (ii)	M1 calculation of actual mass of crystals obtained M2 division by expected mass of crystals (6.4) and multiplication by 100 to convert to percentage M3 correct to 1 dp Example calculation M1 (6.40 – 1.80 =) 4.6(0) M2 (% yield =) $\frac{4.6}{6.4}$ x100 OR 71.875 (%) M3 = 71.9 (%)	M2 ECF M1 M3 DEP M2	3

Question number	Answer	Notes	Marks
10 (c) (i)	M1 find percentage of water M2 divide each percentage by Mr to find number of moles M3 divide each answer by smallest to find ratio and value of x Expected calculation: M1 (79%) $CaSO_4$ 21% H_2O M2 $\frac{79}{136}$ (= 0.58) $\frac{21}{18}$ (= 1.17) M3 $\frac{0.58}{0.58}$ $\frac{1.17}{0.58}$ = 1 : 2 so x = 2	correct answer without working scores 3	3
(ii)	description including M1 do a flame test M2 orange-red flame	ALLOW description of flame test	2

(Total for Question 10 = 15)

Total for paper = 110 marks

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