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Mark Scheme (Results)

January 2021

Pearson Edexcel International GCSE In Chemistry (4CH1) Paper 2CR

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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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<table>
<tr><th colspan="3">Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>(from) solid to liquid</td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>iodine (s) → iodine (g)</td><td></td><td>1</td></tr>
<tr><td></td><td>(b)</td><td></td><td>(diagram showing) particles well spread out with none touching</td><td></td><td>1</td></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th>Statement</th><th>Tick</th></tr>
<tr><td>the particles only vibrate</td><td></td></tr>
<tr><td>the particles do not move</td><td></td></tr>
<tr><td>the particles have no gaps between them</td><td></td></tr>
<tr><td>the particles move randomly</td><td>✓</td></tr>
<tr><td>the particles have more energy than in ice</td><td>✓</td></tr>
<tr><td>the particles have a regular arrangement</td><td></td></tr>
</table>
tick in 4th box (1)
tick in 5th box (1)

if more than two ticks deduct 1 mark for each incorrect tick</td><td></td><td>2</td></tr>
</table>

(Total for Question 1 = 5)

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Question number	Answer	Notes	Marks
2 (a) (i)	(pale/light) yellow		1
(ii)	The correct answer is **B** 1 as bromine is the only liquid at room temperature (20 °C) **A** 0 is incorrect because bromine is a liquid at room temperature (20 °C) **C** 2 is incorrect because bromine is the only liquid at room temperature (20 °C) **D** 3 is incorrect because bromine is the only liquid at room temperature (20 °C)		1
(iii)	At_2		1
(b) (i)	explanation including M1 oxidising agent is chlorine/Cl_2 M2 because chlorine/Cl_2 gains electron(s)/is reduced	 ACCEPT because bromide ions/Br^- lose electrons/are oxidised REJECT bromine ions M2 DEP M1 correct or missing	2

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Question number	Answer	Notes	Marks
2 (b) (ii)	explanation containing three of following points M1 bromine and chlorine react by gaining electron/forming 1- or negative ion M2 bromine atom larger (than chlorine atom) M3 bromine (atom) has smaller/weaker attraction (from nucleus) for (outer shell) electrons (than chlorine) OWTTE M4 so (bromine has) less tendency to gain electron/form negative ion (so less reactive than chlorine) OWTTE	ALLOW bromine has larger atomic radius ALLOW bromine outer (electron) shell further from nucleus ALLOW bromine atom has more (electron) shells (than chlorine) ALLOW reverse argument for chlorine in M2 M3 M4	3
(c)	The correct answer is **D** K^+ and Cl^- because both have electronic configuration of 2.8.8 A is not correct because Li^+ does not have electronic configuration of 2.8.8 B is not correct because F^- does not have electronic configuration of 2.8.8 C is not correct because neither Li^+ nor F^- have electronic configuration of 2.8.8		1

(Total for Question 2 = 9)

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Question number	Answer	Notes	Marks
3 (a)	Explanation including the following points: (metals) M1 contain delocalised electrons M2 (which) move/flow/are mobile/are free to move (through the metal structure) and two from (covalent compounds) M3 contain neutral molecules / molecules with no overall charge M4 electrons held (tightly) in covalent bonds (so) M5 no electrons free to move (so do not conduct)	IGNORE free electrons/sea of electrons M2 dependent on mention of electrons If any mention of ions/atoms moving cannot score M1 M2 ALLOW do not contain ions ALLOW there are no delocalised electrons If state ions present cannot score M3 M4 M5	4
(b)	ion(s)	ALLOW hydrogen ion/H^+ ALLOW chloride ion/Cl^-	1
(c) (i)	all points plotted correctly (within half a small square)		1
(ii)	point at (0.4, 25) circled		1
(iii)	straight line of best fit through origin drawn with ruler		1
(iv)	explanation linking M1 the volume/reading is less than expected M2 because the current was less than 0.4A / some gas escaped/ there was a leak	ALLOW reading taken before 5 minutes	2
(v)	the greater the current the greater the volume (of gas)	ACCEPT directly proportional ACCEPT positive correlation	1

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Question number	Answer	Notes	Marks
3 (d) (i)	(transfer of two/same number of electrons produces) one mole of chlorine/Cl_2 and one mole of hydrogen/H_2	ALLOW same number of moles of chlorine/Cl_2 and hydrogen/H_2 ALLOW molecules for moles	1
(ii)	chlorine dissolves/soluble in acid/solution	ALLOW dissolves/soluble in water	1

(Total for Question 3 = 13)

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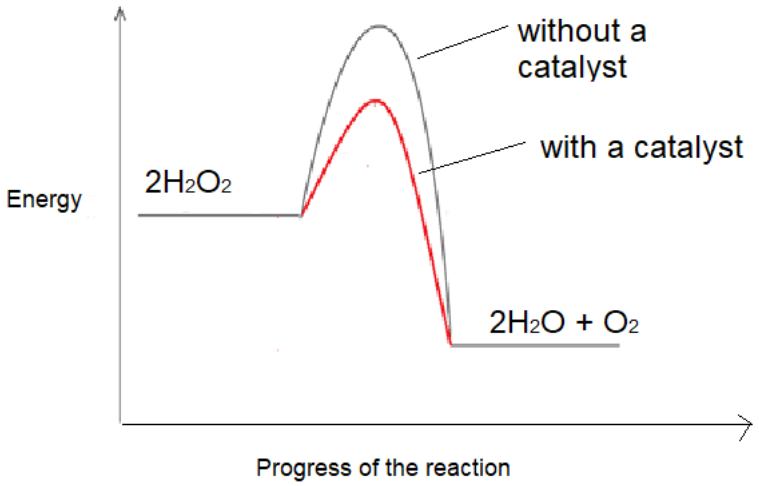
<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>4 (a)</td><td>
<table>
<tr><td>Name</td><td>Structural formula</td><td>Relative formula mass</td></tr>
<tr><td>methanol</td><td>CH_3OH</td><td>32</td></tr>
<tr><td>ethanol</td><td>C_2H_5OH</td><td>46 (1)</td></tr>
<tr><td>butanol (1)</td><td>C_4H_9OH</td><td>74</td></tr>
</table>
</td><td>ALLOW correct names of isomers</td><td>2</td></tr>
<tr><td>(b) (i)</td><td>sulfuric acid</td><td>If oxidation number given must be correct
ALLOW H_2SO_4
IGNORE reference to concentration</td><td>1</td></tr>
<tr><td>(ii)</td><td>from orange to green</td><td></td><td>1</td></tr>
<tr><td>(c) (i)</td><td>ethyl ethanoate</td><td>ALLOW as one word</td><td>1</td></tr>
<tr><td>(ii)</td><td>$CH_3OH + CH_3COOH \rightarrow CH_3COOCH_3 + H_2O$
M1 CH_3COOH
M2 CH_3COOCH_3</td><td>ALLOW displayed formula</td><td>2</td></tr>
</table>

(Total for Question 4 = 7)

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Question number	Answer	Notes	Marks
5 (a)	a catalyst is chemically unchanged at the end of the reaction	ALLOW (provides alternative route for reaction of) lower activation energy ALLOW not used up in reaction	1
(b)	description including six of the following points: M1 do experiment using hydrogen peroxide solution only/without X/Y/Z M2 use known volume of hydrogen peroxide solution OWTTE M3 (and) measure time for certain volume of oxygen gas to be collected OR measure volume of gas collected in a certain time period OWTTE M4 repeat using same volume of hydrogen peroxide solution M5 with known mass/amount of solid X (then Y, then Z) M6 measure time for same volume of oxygen gas to be collected OR measure volume of gas collected in same time period (with solid/X/Y/Z present) M7 after reaction (remove solid/X/Y/Z by filtration and dry) find mass of solid/X/Y/Z /check if mass unchanged M8 reference to reduced time (for certain volume of oxygen gas to be collected) OR increased volume of gas (collected in a certain time period) means X/Y/Z (possible) catalyst (1)	ALLOW measure time until no more oxygen produced ALLOW amount ALLOW reference to increased rate	6

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Question number	Answer	Notes	Marks
5 (c)	M1 labelled profile curve drawn for reaction without catalyst M2 labelled profile curve drawn with lower activation energy for reaction with catalyst  	must start from reactants energy level and end at products energy level	2
(d) (i)	energy needed= [(4 x 463) + 2(146)] = 2144	Ignore sign	1
(ii)	energy released = [(4 x 463)] = 1852	ignore sign	1
(iii)	M1 for showing equation linking between (i), (ii), O=O bond energy and $\triangle H$ M2 correct calculation Example: M1 [1852+ (O=O)] - 2144 = 204 OR (O=O) = 2144 – 1852 + 204 M2 (O=O) = 496	Mark CSQ on (i) and (ii) -496 scores 1 mark	2

(Total for Question 5 = 13)

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<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>6 (a) (i)</td><td>pipette</td><td>ALLOW graduated pipette</td><td>1</td></tr>
<tr><td>(ii)</td><td>The correct answer is D yellow because methyl orange is yellow in alkaline solution
A is incorrect because methyl orange is not blue in alkaline solution
B is incorrect because methyl orange is not orange in alkaline solution
C is incorrect because methyl orange is not red in alkaline solution</td><td></td><td>1</td></tr>
<tr><td>(b) (i)</td><td>ticks under titration numbers 1, 2 and 4
<table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>20.65</td><td>20.60</td><td>20.90</td><td>20.55</td></tr><tr><td>✓</td><td>✓</td><td></td><td>✓</td></tr></table></td><td></td><td>1</td></tr>
<tr><td>(ii)</td><td>M1 $\frac{(20.65 + 20.60 + 20.55)}{3}$ =
M2 20.60</td><td>M1 CSQ on results ticked
M2 CSQ on correct calculation from M1

Answer to M2 must be correct to 2dp

20.60 without working scores 2
20.6 with or without working scores 1

If no ticks then only use of 2 or 3 concordant titres can score M1 and M2 in (ii)

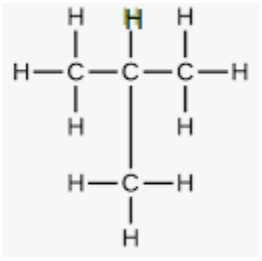
If only one tick then M2 can be scored for averaging two or more titre values correctly</td><td>2</td></tr>
</table>

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Question number	Answer	Notes	Marks
6 (c) (i)	M1 mol (KOH) = $\frac{0.0370 \times 25}{1000}$		2
	M2 = 9.25×10^{-4} / 0.000925	ALLOW any number of sig fig except one If no division by 1000 giving answer of 0.925 award 1 mark correct answer with no working scores 2	
(ii)	M2 from (i) divided by 2 expected answer 4.625×10^{-4} / 0.0004625	ALLOW any number of sig fig except one	1
(iii)	M1 answer to $\frac{\text{(ii)} \times 1000}{21.20}$		2
	M2 correctly evaluated expected answer if (i) and (ii) correct 0.0218	ACCEPT any number of sig fig except one (unless ECF answer is exactly 1 sig fig) correct answer with no working scores 2	

(Total for Question 6 = 10)

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Question number	Answer	Notes	Marks
7 (a)	M1 use of amount in moles = $\frac{\text{volume of gas}}{\text{molar volume}}$ M2 correct evaluation Example calculation M1 amount in moles = $\frac{600}{24000}$ M2 = 0.025 (mol)	0.025 with no working scores 2 REJECT 0.03 for M2	2
(b)	M1 statement/use of amount in moles = $\frac{\text{mass}}{Mr}$ M2 substitution and correct evaluation: $Mr = \frac{1.45}{0.025} = 58$		2
(c)	molecular formula = C_4H_{10} = (4 x 12) + (10 x 1) = 58 OR alkane general formula = C_nH_{2n+2} so M1 (nx12) + (2n+2)x1 = 58 so 14n = 56 M2 n =4 so C_4H_{10}		1
(d)			1

(Total for Question 7 = 6)

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Question number	Answer	Notes	Marks
8 (a) (i)	$NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$		1
(ii)	M1 moist/damp red litmus paper M2 turns blue	ALLOW moist/damp universal indicator paper	2
(b)	an explanation linking following two points: M1 forward and backward/reverse reactions are taking place at same rate M2 the concentrations of reactants and products remain constant	ACCEPT reaction is taking place in both directions at same rate REJECT concentrations of the reactants and products are equal/the same	2
(c)	an explanation linking following two points: M1 as temperature decreases yield of ammonia (formed in forward reaction) increases M2 so forward reaction is exothermic	ALLOW as temperature decreases equilibrium position shifts in forward direction/(from left) to right (producing more ammonia) IGNORE references to pressure ALLOW reverse arguments IGNORE references to Le Chatelier's Principle M2 DEP M1	2

(Total for Question 8 = 7)

Total for Paper = 70 marks

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