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Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 2C

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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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Question number	Answer	Notes	Marks
1 (a) (i)	M1 a compound/substance/molecule containing hydrogen/H and carbon/C (atoms) M2 only	no M1 if reference to element containing C and H OR C and H molecules M2 dep on M1 or near miss	2
(ii)	ethene has a double bond		1
(b)	A colourless A is the only correct answer because alkenes such as ethene react with bromine water forming a colourless solution B is not correct as bromine water is orange before it reacts with ethene C is not correct as the solution produced is not purple D is not correct as the solution produced is not red		1
(c) (i)	temperature = 300°C pressure = 60-70 atmospheres	ACCEPT any value or range of values between 250 and 350°C If no unit given assume it is Celsius ACCEPT equivalent temperatures in other units provided the unit is given ACCEPT any value or range of values between 60 and 70 atm If no unit given assume it is atm ACCEPT equivalent pressures in other units provided the unit is given	2
(ii)	C_2H_6O	IGNORE size of numbers REJECT C_2H_5OH	1
			Total for question = 7

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Question number	Answer	Notes	Marks
2 (a) (i)	D nitrogen D is the only correct answer as nitrogen is the most abundant gas in unpolluted air. A is not correct as there are only trace amounts of hydrogen in unpolluted air. B is not correct as there are only trace amounts of methane in unpolluted air. C is not correct as there are only trace amounts of neon in unpolluted air.		1
(ii)	C 21% C is the only correct answer as the percentage of oxygen in the air is 21% A is not the correct answer as the percentage of oxygen in the air is not 0.04% B is not the correct answer as the percentage of oxygen in the air is not 0.9% D is not the correct answer as the percentage of oxygen in the air is not 35%		1
(b) (i)	cracking an alkane: ☐ complete combustion of an alkane: ✔ reaction between magnesium and hydrochloric acid: ☐ rusting of iron: ☐ thermal decomposition of copper(II) carbonate: ✔		2
(ii)	Any one from: M1 global warming M2 climate change	ALLOW greenhouse effect ALLOW an effect of global warming/climate change e.g. wildfires/ melting of polar ice caps/flooding	1
(iii)	argon		1
(c) (i)	nitric acid	ALLOW HNO_3/ nitrous acid /HNO_2	1
(ii)	sulfur dioxide	ALLOW SO_2 ALLOW other oxides of nitrogen	1
			Total for question = 8

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Question number	Answer	Notes	Marks
3 (a) (i)	M1 working shown on graph M2 56 (°C)	 ALLOW any value between 56 and 57 inclusive.	2
(ii)	M1 31-13 M2 18 (g)	 ALLOW ecf if one incorrect reading in M1 correct answer of 18g with or without working scores 2	2
(b) (i)	5.1 (g)		1
(ii)	15 (g)		1
(iii)	M1 5.1÷15 **OR** 0.34 (g) **OR** answer to (i) ÷ answer to (ii) M2 34 (g) **OR** answer to M1 × 100	 correct answer of 34 (g) with or without working scores 2	2
(iv)	Any one from M1 (hydrated) copper(II) sulfate would become anhydrous copper sulfate M2 (hydrated) copper(II) sulfate would lose water	 ALLOW the (hydrated) crystals would decompose	1
			Total for question = 9

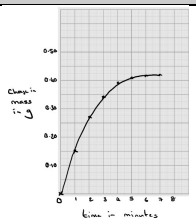
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Question number	Answer	Notes	Marks
4 (a) (i)	Any two from: M1 sodium moves (on the surface) M2 sodium turns into a sphere/ball M3 effervescence M4 sodium gets smaller M5 white trail seen	 ALLOW sodium melts ALLOW fizzing / bubbles ALLOW sodium disappears / dissolves IGNORE references to a flame	2
(ii)	blue / purple	IGNORE qualifiers ALLOW violet/lilac	1
(b) (i)	same number of electrons/one electron in the outer shell.	ALLOW same number of valence electrons/one valence electron	1
(ii)	M1 lithium (atom) has a smaller atomic radius M2 the outer shell electron is more strongly attracted to the nucleus OWTTE M3 so is less easily lost	ALLOW lithium is smaller (atom)/lithium (atom) has fewer shells /energy levels ALLOW outer electron in lithium (atom) is closer to the nucleus ALLOW reverse argument for sodium	3
(c)	M1 amount lithium = 0.150 ÷ 7 **OR** 0.0214 mol M2 amount hydrogen = 0.0107 mol M3 254 ÷ 0.0107 M4 23,738	penalise 1 sig fig in M1 ALLOW M1÷2 ALLOW 2 or more sig figs in answers to M1 and M2 ALLOW 2 or more sig figs if all working shown correct answers in the range 23,707 to 24,910 cm^3 to 3 or more significant figures, without working scores 4 marks.	4
			Total for question = 11

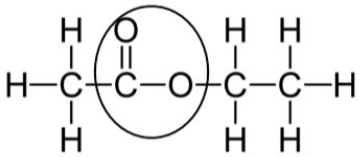
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Question number	Answer	Notes	Marks
5 (a)	A description that refers to any five of the following points M1 add hydrogen peroxide to the conical flask and add catalyst M2 start the timer M3 record volume of gas produced in a given time/ record the time for certain volume of gas to be produced M4 repeat with same mass of a different catalyst M5 and with same volume of hydrogen peroxide M6 plot the results on a graph and calculate gradient (for each catalyst) M7 the most effective catalyst gives the fastest rate of reaction OWTTE		5
(b) (i)	M1 a vertical line from the level of the hydrogen peroxide to the top of the curve labelled activation energy or E_a M2 a vertical line from the level of the hydrogen peroxide to the level of the water and oxygen labelled enthalpy change or ΔH	the line does not need an arrow head ALLOW double headed arrow REJECT arrow pointing down ALLOW double headed arrow REJECT arrow pointing up	2
(ii)	curve starting from hydrogen peroxide level, below the peak of the original curve, and ending at water and oxygen level		1
			Total for question = 8

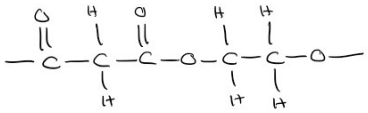
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Question number	Answer	Notes	Marks
6 (a) (i)	all points plotted ± half a square		1
(ii)	curved line of best fit		1
(iii)	An explanation that links the following two points M1 curve shows increasing mass (of negative electrode) because (more) copper deposits/forms M2 line becomes horizontal because there are no more copper(II) ions left in the solution/ all the copper has been deposited/formed OWTTE	 ALLOW line becomes horizontal as there is no copper sulfate solution left	2
(b) (i)	A description that refers to two of the following points M1 fill a test tube/measuring cylinder with copper sulfate solution M2 place the tube over the positive electrode M3 collect gas/oxygen by displacement of solution/water	 ALLOW fill a test tube/ measuring cylinder with water	2
(ii)	$2H_2O \rightarrow O_2 + 4H^+ + 4e^{(-)}$ M1 all formulae correct M2 correct balancing of correct formulae **OR** $4OH^- \rightarrow O_2 + 2H_2O + 4e^{(-)}$ M1 all formulae correct M2 correct balancing of correct formulae	 M2 dep on M1 M2 dep on M1	2
(c) (i)	M1 layers (of atoms or ions) M2 can slide over one another	ALLOW sheets/rows M2 dep on M1 ALLOW atoms/ions slide over each other for M2	2
(ii)	M1 delocalised electrons M2 are free to move (throughout the structure)	IGNORE sea of electrons /free electrons M2 dep on mention of electrons in M1 0 marks if reference to ions moving	2
			Total for question = 12

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Question number	Answer	Notes	Marks
7 (a) (i)		REJECT any other atoms in the ring.	1
(ii)	ethyl ethanoate	ALLOW ethylethanoate ALLOW ethyl acetate	1
(iii)	M1 add a metal such as magnesium, aluminium, zinc or iron M2 effervescence/bubbles/fizzing **OR** M1 add a carbonate M2 effervescence/bubbles/fizzing	must be a named metal REJECT Group 1 metals ACCEPT test gas with lighted splint which pops M2 dep on reference to adding a metal ACCEPT any named carbonate ACCEPT test gas with limewater which goes cloudy/milky M2 dep on M1	2
(b)	M1 C-O and one / two O-H bonds are broken and formed M2 so the same amount of energy is needed to break the bonds in the reactants as is given off when the bonds in the products are formed	ALLOW the same bonds are broken and formed ALLOW energy of bonds formed equals energy of bonds broken	2
(c) (i)	M1 the rate of the forward reaction equals the rate of the backward reaction M2 the concentrations of reactants and products remain constant	 REJECT concentration of the reactants and products are the same	2
(ii)	M1 a catalyst increases the rate of forward and backward reactions M2 equally	 M2 dep on M1	2

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Question number	Answer	Notes	Marks
7 (d)	example calculation M1 moles barium hydroxide = (0.150 × 22.75)÷ 1000 **OR** 0.0034125 M2 moles ethanoic acid = 0.006825 M3 moles ethanoic acid to 3 significant figures = 0.00683	M1 needs to be given to at least 3 sig figs ALLOW M1 × 2 ALLOW answer to M2 to 3 significant figures. correct answer of 0.00683 moles with or without working scores 3 marks ACCEPT answer in standard form ACCEPT 0.00682 if M1 given to 3 sig figs 6.83 with or without working scores 2 marks	3
(e)	correct answer scores 2 marks  M1 three carbons from the dicarboxylic acid and two from the diol and the ester linkage M2 -OH lost from the dicarboxylic acid and -H lost from the diol	ALLOW structure without extension bonds IGNORE brackets and n and + H_2O ALLOW -OH lost from diol and -H lost from dicarboxylic acid	2
			Total for question = 15

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