Pearson Edexcel

Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1C

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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)	nucleus	**ACCEPT** nuclei	1
(b)	11 / eleven		1
(c)	1 / one / group 1		1
(d)	3 / three / period 3		1
(e)	+1 / 1+	**ACCEPT** + / Na^+ / positive 1 **IGNORE** positive alone	1
			Total 5

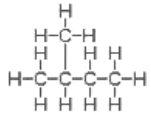
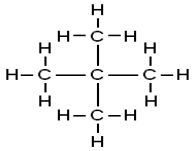
Question number	Answer	Notes	Marks
2 (a)	<table><tr><th>Change</th><th>Change of state</th></tr><tr><td>water to ice</td><td>freezing</td></tr><tr><td>steam to water</td><td>condensation</td></tr><tr><td>solid wax to liquid wax</td><td>melting</td></tr><tr><td>iodine crystals to iodine vapour</td><td>sublimation</td></tr></table>	**ALLOW** condensing **ALLOW** subliming	4
(b) (i)	**M1** heat **M2** stir / mix	**ALLOW** use hot water **IGNORE** add more water **ALLOW** grind / crush the solid / mixture	2
(ii)	filter	**ALLOW** a description of filtration	1
			4

(iii)	A description that refers to four of the following points: **M1** heat / boil (the solution) **M2** evaporate some of the water **M3** leave / cool (the solution to crystallise) **M4** pour off excess liquid **OR** filter (to obtain crystals) **M5** suitable method of drying the crystals	**IGNORE** any steps before heating the solution **ALLOW** until crystals form on the end of a glass rod **ALLOW** until crystals first start to form **ALLOW** until the solution is saturated **M3** dep on **M1** **M4** dep on crystals having been formed **IGNORE** references to washing e.g. place in an oven / leave to dry /use filter paper / kitchen towel / / desiccator / heat to dryness If solution heated until **all** the water evaporates / heated until **all** the water has been removed / heated to **dryness** award **M1** and **M5** If the solution is left to evaporate **all** of the water only **M5** can be awarded.	**Total 11**

Question number			Answer	Notes	Marks
3	(a)	(i)	(crude oil/it is) heated / vapourised	**ALLOW** evaporated / boiled **REJECT** melted	1
		(ii)	gasoline	**ALLOW** petrol	1
		(iii)	road (surfacing) / roofs / tarmac		1
	(b)	(i)	**M1** silica / alumina (catalyst) **M2** 600 to 700 °C	**ACCEPT** SiO_2/Al_2O_3 / silicon dioxide / aluminium oxide /aluminosilicates / zeolites	2
		(ii)	Any two from: **M1** shorter-chain <u>alkanes</u> are in high(er) demand / more useful / used for petrol / more flammable **M2** <u>alkenes</u> are needed / used to make polymers	**ALLOW** <u>C_8H_{18}</u> is in high(er) demand (than $C_{13}H_{28}$) / more useful / used for petrol / more flammable **IGNORE** shorter-chain alkanes are used as fuels **ALLOW** <u>C_2H_4</u> / <u>C_3H_6</u> are needed / used to make polymers / plastics shorter chain hydrocarbons **/** the products are in high(er) demand / more useful / more flammable scores 1 **if no other mark awarded** to create shorter alkanes and alkenes scores 1 **if no other mark awarded**	2

(c)	An explanation that links the following three points: **M1** sulfur dioxide produced when fuel is burned **M2** (sulfur dioxide) dissolves in / reacts with rain / water **M3** (causing) acid rain	 **ALLOW** sulfur / fuel reacts with oxygen / oxidises forming sulfur dioxide **IGNORE** sulfur trioxide and sulfur oxide **ACCEPT** (sulfur oxide / sulfur trioxide) dissolves in / reacts with rain / water **IGNORE** mixes	3
			Total 10

Question number	Answer	Notes	Marks
4 (a) (i)	water is needed for iron to rust / react	**ALLOW** reaction needs water (and oxygen) **ALLOW** increases rate of reaction	1
(ii)	brown (coating on iron)	**ALLOW** red-brown / orange-brown / orange / orange-red **IGNORE** red alone	1
(iii)	Fe_2O_3		1
(iv)	An explanation that links the following two points **M1 (**the powder has) a larger surface area **M2** so the iron will rust quicker/ the reaction will be faster / the results are (obtained) more quickly	 **ALLOW** (the powder has) higher surface area:volume **IGNORE** references to the collision theory	2
(b)	syringe reading at start: 81 syringe reading at end: 16 change in volume in cm^3: 65	**ALLOW** ecf on syringe reading at start if syringe reading at end read incorrectly correct volumes the wrong way round scores **1**	2
(c)	**M1** (volume of oxygen =) 90 – 22 **OR** 68 (cm^3) **M2** (total volume at start =) 260 + 90 **OR** 350 (cm^3) **M3** $\frac{68 \times 100}{350}$ = 19.4 (%)	correct answer without working scores 3 **ALLOW** ecf on **M1** and **M2** in **M3** as long as the answer is less than 100% **ACCEPT** any number of sig figs except 1 26.2 (%) scores 2 25.7 (%) scores 2 75.6 (%) scores 2 34.6 (%) scores 1	3 **Total 10**

Question number	Answer	Notes	Marks
5 (a) (i)	**M1** (compounds with) same molecular formula	**ALLOW** same number of carbons and hydrogens / atoms of each element	2
	M2 different structural / displayed formulae	**ALLOW** different structures / arrangement of atoms	1
(ii)	(5 x 12 + 12 x1 =) 72		1
(iii)	pentane	spelling must be correct	1
(iv)	**M1** 	either order	2
	M2 		

(b)	A description that refers to any five of the following points: **M1** ethane needs UV (radiation) to react **M2** ethane produces bromoethane **M3** ethane produces hydrogen bromide / HBr **M4** reaction with ethane involves breaking C-H bond / reaction with ethene involves breaking C=C bond **M5** ethane reaction is substitution **M6** ethene produces dibromoethane **M7** ethene reaction is addition	**IGNORE** any colour changes given **IGNORE** UV for ethene **IGNORE** any references to temperature and pressure **ALLOW** formulae **ALLOW** formula **M1, M2, M3** and **M6** can be scored from word or chemical equations	5 **Total 11**

Question number			Answer	Notes	Marks
6	(a)	(i)	$Mg + 2HCl \rightarrow MgCl_2 + H_2$	**IGNORE** state symbols even if incorrect	1
		(ii)	(squeaky) pop with lighted splint		1
		(iii)	**M1** amount of magnesium = 0.090 ÷ 24 **OR** 0.00375 (mol) **M2** amount of HCl needed = 2 × 0.00375 = 0.0075 (mol) (which is less than 0.025) **OR** **M1** amount of magnesium needed = 0.025÷2 **OR** 0.0125 (mol) **M2** mass of magnesium needed = 0.0125 × 24 = 0.3(g) (there is less magnesium than needed)	**ALLOW** any number of significant figures	2
	(b)	(i)	all points plotted correctly to the nearest grid line		1
		(ii)	best fit curve starting at 0 and levelling off at 88 cm^3		1
		(iii)	**M1** vertical line on grid from 10 seconds to curve **M2** volume correctly read from their graph to the nearest grid line	**ALLOW** any mark at correct position on curve / either axis expected value 25 to 30 cm^3	2
		(iv)	An explanation that links the following two points **M1** concentration (of HCl) is greatest (at the start) **M2** more collisions per unit time / more frequent collisions	**REJECT** incorrect references to energy **ALLOW** more particles (of HCl / more H^+ ions) **ALLOW** more HCl molecules / greater surface area of Mg **IGNORE** greater mass /more Mg **IGNORE** references to the graph	2

(c)	(i)	**M1** curve starting at 0 and steeper than original curve **M2** curve levelling off at same volume as original curve	**ALLOW** a curve starting within 1 small square of the original	2
	(ii)	An explanation that links the following three points		3
		M1 particles gain more (kinetic) energy	**ALLOW** particles move faster	
		M2 more collisions have energy greater than the activation energy	**ACCEPT** more collisions are successful	
		M3 collision frequency increases **OR** rate of reaction increases	**ACCEPT** more (successful) collisions per unit time	
				Total 15

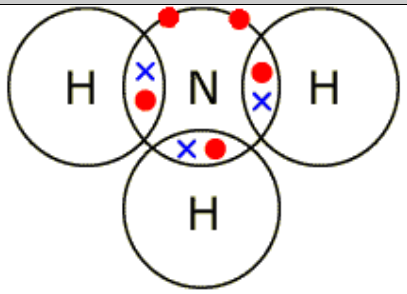
Question number			Answer	Notes	Marks
7	(a)	(i)	**M1** <u>atoms</u> of the same element / <u>atoms</u> with the same number of protons /<u>atoms</u> with the same atomic number	**REJECT** different number of electrons **IGNORE** same number of electrons	2
			M2 (with a) different number of neutrons / different mass number		
		(ii)		correct answer without working scores 3	3
			M1 (63 x 69.5) + (65 x 30.5) **OR** 6361		
			M2 their **M1** ÷ 100 **OR** 63.61		
			M3 63.6	**ALLOW** answer to **M2** to 3 sig figs 63.61 without working scores 2	
	(b)	(i)	**A** decomposition B is incorrect as it is not a neutralisation reaction C is incorrect as it is not an oxidation reaction D is incorrect as it is not a reduction reaction		1
		(ii)	**C** green to black A is incorrect as copper(II) carbonate is not blue B is incorrect as copper(II) carbonate is not blue and copper(II) oxide is not white D is incorrect as copper(II) oxide is not orange		1
	(c)	(i)	(28.20 − 20.52 =) 7.68		1
		(ii)	(31.77 − 28.20 =) 3.57		1

(iii)	**M1** 7.68 ÷ 159.5 **OR** 0.04815 **M2** 3.57 ÷ 18 **OR** 0.1983 **M3** 0.1983 ÷ 0.04815 **OR** 4.12	correct answer without working scores 3 **ALLOW** ecf from (i) and/or (ii) for **M1** and **M2**; and **M3** provided the answer rounds to 4 **REJECT** incorrect rounding in **M1** or **M2** **ALLOW** any number of sig figs in **M1** and **M2** except 1 Penalise 1 sig fig once only	3
(iv)	not all the water was removed (from the hydrated copper(II) sulfate)	**ALLOW** the (hydrated copper(II) sulfate) was not heated for long enough **ALLOW** not all the water left the tube (that was being heated) **ALLOW** not all the (hydrated copper sulfate) reacts	1 **Total 13**

Question number	Answer	Notes	Marks
8 (a)	**M1** diamond has a tetrahedral (structure) **OR** in diamond each (carbon) atom is (covalently) bonded to 4 other (carbon) atoms **M2** graphite has a hexagonal (structure) / has layers **OR** in graphite each (carbon) atom is (covalently) bonded to 3 other (carbon) atoms **M3** diamond does not conduct electricity **OR** graphite conducts electricity **M4** diamond has no delocalised electrons **OR** graphite has delocalised electrons **M5** diamond is hard **OR** graphite is soft **M6** in diamond the strong (C-C) bonds need to be broken **OR** in graphite the layers can slide over each other **OR** graphite has weak forces between layers	**REJECT** ions / metallic once in **M1** or **M2** **REJECT** diamond is soft / graphite is hard **REJECT** reference to intermolecular	6
(b)	An explanation that links the following four points: **M1** C_{60} fullerene has weak forces between the molecules /weak intermolecular forces **M2** little / less energy needed to break / overcome the forces /separate the molecules **M3** diamond and graphite have many / strong (covalent) bonds (between atoms) **M4** large amount of /more energy needed to break /overcome the (covalent) bonds	no **M1** or **M2** if reference to breaking bonds in fullerene no **M3** or **M4** if reference to intermolecular forces in diamond and graphite If **M1** and **M3** are not scored allow 1 mark for covalent bonds (in diamond and graphite) need to be broken / overcome **AND** intermolecular forces need to be broken / overcome in fullerene	4 **Total 10**

Question number	Answer	Notes	Marks
9 (a) (i)	$PbO(s) + H_2(g) \rightarrow Pb(s) + H_2O(l$ **OR** $g)$	**ALLOW** upper case letters for state symbols	1
(ii)	**D** 2+ A is incorrect as the charge on the lead ion is not 1- B is incorrect as the charge on the lead ion is not 1+ C is incorrect as the charge on the lead ion is not 2-		1
(iii)	An explanation that links either pair of the two points **M1** lead oxide is reduced **and** hydrogen is oxidised **M2** lead oxide loses oxygen **and** hydrogen gains oxygen **OR** **M1** lead oxide loses oxygen so is reduced **M2** hydrogen gains oxygen so is oxidised	**ACCEPT** lead oxide is the oxidising agent and hydrogen is the reducing agent **ACCEPT** lead ions gain electrons and hydrogen loses electrons **ACCEPT** lead ions gain electrons so are reduced **ACCEPT** hydrogen loses electrons so is oxidised **ALLOW** oxidation number of lead / Pb^{2+} decreases from +2 to 0 so is reduced for M1 Oxidation number of hydrogen increases from 0 to +1 so is oxidised for M2	2
(iv)	A description that refers to the following two points: **M1** measure the boiling point (of the water) **M2** (boiling point is) 100 °C	**ALLOW** boil it **/** measure the freezing point / freeze it **ACCEPT** (freezing point is) 0 °C	2

(b)	(i)	An explanation that links the following two points: **M1** heat the crucible **M2** repeat until constant mass is obtained	 **ALLOW** repeat the experiment heat to constant mass scores 2	2 3
	(ii)	**M1** (moles of Pb_3O_4 =) 5.48 ÷ 685 **OR** 0.008(00) **M2** (moles of PbO =) 0.008(00) x 3 **OR** 0.024(0) **M3** (mass of PbO =) 0.024 x 223 = 5.352 (g)	correct final answer without working scores 3 **ALLOW** ecf as long as an attempt has been made to find moles **ALLOW** answer to M1(if no **M2**) or **M2** x 223 **ALLOW** any number of sig figs except 1	 **Total 11**

Question number	Answer	Notes	Marks
10 (a)	 **M1** 3 bonding pairs **M2** rest of molecule fully correct	**M2** dep on **M1** **ALLOW** any combination of dots and crosses	2
(b) (i)	<table><tr><td>**M1** ammonium chloride</td><td>ammonium carbonate</td></tr><tr><td>NH_4Cl</td><td>**M2** $(NH_4)_2CO_3$</td></tr></table>		2
(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	**ALLOW** multiples **IGNORE** state symbols even if incorrect	1
(iii)	**M1** add sodium hydroxide (solution) **M2** test (gas / ammonia) with (damp) red litmus paper / (damp) universal indicator paper **M3** (red litmus) turns blue / universal indicator) turns blue / purple	**REJECT** if solution / ammonium (sulfate) tested with litmus / universal indicator paper	3

(c)	(i)	**M1** 2 x 14 ÷ 80 **OR** 0.35 **M2** (0.35 x 100 =) 35 (%)	correct answer without working scores 2 **ALLOW** 1 mark for 17 / 17.5 / 18 (%)	2
	(ii)	An answer that links any 4 points: **M1** (NH_3) higher % of N **OR** (($(NH_4)_2SO_4$) lower % of N **M2** $(NH_4)_2SO_4$ easy to use (to soil) **/** easy for the plants to absorb / less wastage **OR** (NH_3) difficult to use (to soil) **/** difficult for the plants to absorb / more wastage / has to be dissolved (in water) first **M3** $(NH_4)_2SO_4$ pH close to that of (rain) water **/** will not alter the pH (of the soil/water) **M4** NH_3 will cause (the soil/water) to become alkaline / will raise the pH (of the soil/water**)** / neutralise (the water / soil) / may stunt growth of plants / may damage / kill plants **M5** NH_3 and or $(NH_4)_2SO_4$ soluble so runoff / wastage of fertiliser / water pollution / eutrophication / leaching	 **REJECT** NH_3 has a pH close to rainwater **REJECT** ammonia causes the soil / water to become acidic	4 **Total 14**

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