Mark Scheme (Results)

November 2023

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.

Question number	Answer	Notes	Marks
1 (a)	**B (9)** A is incorrect as there are not 7 electrons in total C is incorrect as there are not 10 electrons in total D is incorrect as there are not 19 electrons in total		1
(b)	**A (1–)** B is incorrect as the charge on a bromide ion is not 1+ C is incorrect as the charge on a bromide ion is not 2– D is incorrect as the charge on a bromide ion is not 2+		1
(c)	**C (grey solid)** A is not correct as iodine is not a brown liquid at room temperature B is not correct as iodine is not a brown solid at room temperature D is not correct as iodine is not a purple gas at room temperature		1
(d)	An explanation that links the following three points **M1** chlorine displaces bromine and iodine/chlorine reacts with bromide and iodide (ions) **M2** bromine displaces iodine/iodine doesn't displace chlorine or bromine /bromine reacts with iodide (ions) /iodine doesn't react with chloride or bromide (ions) **M3** most reactive chlorine bromine least reactive iodine	**ALLOW** chlorine has two reactions **ALLOW** iodine has no reactions **ACCEPT** chlorine is most reactive and iodine is least reactive **ALLOW** reactivity decreases down the group Deduct 1 mark only for incorrect use of **ide** or **ine**	3
			Total 6

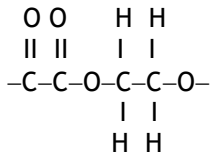
Question number	Answer	Notes	Marks
2 (a) (i)	white solid/powder/ash	**ALLOW** (pale/light) grey solid/powder /ash **REJECT** white precipitate **IGNORE** bright/white flame	1
(ii)	$2Mg + O_2 \rightarrow 2MgO$	**ALLOW** multiples and fractions **IGNORE** state symbols even if incorrect	1
(iii)	An explanation that links the following two points **M1** (oxygen is used in the reaction so) volume/amount of air/oxygen decreases /pressure decreases **M2 (**water level rises) to take the place of the oxygen /to equalise the pressure OWTTE	**ALLOW** arguments in terms of pressure	2
(b)	**M1** percentage of oxygen in air = 21% /percentage of air remaining = 79% **M2** volume of air remaining = $\frac{2000 \times 79}{100}$ (cm^3) **M3** 1580 (cm^3)	**ALLOW** 20% / 80% **M2** subsumes **M1** **ALLOW** ecf if incorrect percentage used use of 80% gives an answer of 1600 (cm^3) correct answer of 1580 or 1600 without working scores 3 420 /400 scores 2	3
(c)	The percentages of argon and carbon dioxide are very small OWTTE	**ACCEPT** references to approximate percentages **ALLOW** (all the oxygen has been removed and) only 1% / small amounts of the other gases remain	1
			Total 8

Question number	Answer	Notes	Marks
3 (a)	aluminium/it is more reactive than carbon/aluminium/it is above carbon in the reactivity series ORA		1
(b)	An explanation which links two pairs of points **Pair 1** **M1** drink cans **M2** malleable/low density **Pair 2** **M1** aircraft/aeroplanes/bicycle frames/car bodies **M2** low density **Pair 3** **M1 (**overhead) power cables **M2 (**good) conductor of electricity /low density /malleable /ductile **Pair 4** **M1** pans **M2 (**good) conductor of heat **Pair 5** **M1** (aluminium) foil **M2** malleable	In all cases **M2** is dep on **M1** **ALLOW** does not corrode/ non-toxic/doesn't react with the drink **ALLOW** does not corrode **ALLOW** wires **ALLOW** does not corrode/ non-toxic /doesn't react with the food **ALLOW** does not corrode/ non-toxic /doesn't react with the food /prevents heat loss **ACCEPT** any correct use with corresponding relevant property **REJECT** any incorrect answer for **M2**	4

(c)	An explanation that links the following three points **M1** in pure metal layers (of atoms/cations /particles) slide over each other (easily) OWTTE **M2** in an alloy the different sized/larger atoms /cations/particles disrupt the structure/are more randomly arranged **M3** which prevents layers (of atoms/cations /particles) sliding over each other	**ALLOW** sheets/rows for layers **REJECT** molecules /intermolecular forces /negative ions /anions /ionic /covalent for 1 mark only Deduct 1 mark if no mention of layers/sheets/rows	3
			Total 8

Question number	Answer	Notes	Marks
4 (a)	Any two from **M1** concentration of sodium hydroxide (solution) **M2** rate of / same stirring **M3** temperature of sodium hydroxide (solution)	 **IGNORE** references to concentration of acid **IGNORE** references to volume / mass / amount of either solution **ALLOW** temperature of the room /environment	2
(b)	An explanation that links any two of the following points **M1** polystyrene/it is a better insulator than glass OWTTE **M2** less heat/thermal energy will be lost **M3** using a polystyrene cup will lead to a more accurate/a higher <u>temperature</u> (change)	 **ALLOW** polystyrene/it is an insulator **ALLOW** prevents heat loss /retains heat	2
(c) (i)	any value between 32.0 and 33.0 inclusive		1
(ii)	An explanation that links the following three points **M1** the first line shows that as more sodium hydroxide is added the temperature rises (at a steady rate) **M2** the point where the lines cross/ the highest temperature reached/ the volume of 21-22 cm^3 of sodium hydroxide shows that the sodium hydroxide has neutralised the acid/ the acid has fully reacted **M3** the second line shows that (there is no further reaction and) the cool sodium hydroxide solution decreases the temperature OWTTE	 **ACCEPT** the temperature is directly proportional to the volume added **ALLOW** there is a positive correlation between the temperature and the volume added **ALLOW** the second line shows that there is no further reaction as the mixture cools down OWTTE	3

(d)	**M1** mass of solution = 25 + 22 **OR** 47 (g) **M2** $Q = mc\Delta T$ **OR** $Q = 47 \times 4.2 \times 35$ **M3** 6909 (J) **M4** 6.9 (kJ)	correct answer without working scores 4 **ALLOW** ecf from **M1** if incorrect mass used e.g. use of 1, 22 or 25 **M2** subsumes **M1** **ALLOW** ecf from **M3** if correct conversion from J to kJ 147 /3234 /3675 (J) score 2 0.147 / 3.234 / 3.675 (kJ) score 3 **ACCEPT** any number of significant figures correctly rounded except 1	4
			Total 12

Question number	Answer	Notes	Marks
5 (a) (i)	$2CH_3COOH + Mg \rightarrow (CH_3COO)_2Mg + H_2$ **M1** $2CH_3COOH + Mg$ **M2** H_2	**ALLOW** multiples and fractions **ALLOW** $2C_2H_4O_2$ **REJECT** $2CH_4COO$ **IGNORE** state symbols even if incorrect	2
(ii)	**M1** effervescence/fizzing/bubbles **M2** magnesium becomes smaller/disappears	**IGNORE** gas evolved **ALLOW** dissolves	2
(b) (i)	(concentrated) sulfuric acid	**ALLOW** any suitable inorganic acid e.g. hydrochloric or nitric or phosphoric **IGNORE** dilute	1
(ii)	**C ($CH_3CH_2COOCH_3$)** A is incorrect as it is propyl methanoate B is incorrect as it is propyl ethanoate D is incorrect as it is methyl butanoate		1
(c) (i)	condensation (polymerisation)		1
(ii)	water	**ALLOW** H_2O	1
(iii)	 **M1** correct displayed ester functional group **M2** rest of structure correct	**ALLOW** structure without extension bonds O can be on LHS instead of on RHS **IGNORE** brackets and n	2
(d)	(a polyester that) is biodegradable	**ACCEPT** can be degraded by bacteria **ALLOW** can be decomposed	1
			Total 11

Question number	Answer	Notes	Marks
6 (a)	**M1** (X) pipette **M2** (Y) burette		2
(b)	methyl orange/phenolphthalein/litmus (solution)	**REJECT** universal indicator **REJECT** litmus paper **IGNORE** pp indicator **ACCEPT** other alternative appropriate indicators	1
(c) (i)	**M1** (moles of Na_2CO_3 =) $\frac{0.220 \times 25.0}{1000}$ **OR** 0.0055(0) **M2** (moles of HNO_3 =) 0.0055(0) × 2 **OR** 0.011(0) **M3** (volume of HNO_3 = $\frac{0.011(0) \times 1000}{0.350}$ =) 31.4 (cm^3)	Correct answer without working scores 3 If they use mega moles can still score 3 for 31.4 **ALLOW** ecf from **M1** **ALLOW** ecf on incorrect moles in **M2** **ACCEPT** any number of sig figs except 1 **ACCEPT** alternative methods 7.86 /7.9 /7.857 scores 2 15.7 /16 scores 2	3
(ii)	**M1** (moles of Na_2CO_3 = $\frac{0.220 \times 25.0}{1000}$ = 0.0055(0) so) moles of CO_2 = 0.0055(0) **M2** (volume of CO_2 = 0.0055(0) × 24 000 =) 132 (cm^3)	Correct answer without working scores 2 **ALLOW** ecf on incorrect number of moles from (i) If they use mega moles in (i) only 1 mark for 132000	2

(d)	A description that refers to the following three points **M1** add (dilute) hydrochloric acid (to the sodium carbonate) **M2** bubble/pass the gas through limewater **OR** test the gas with limewater **M3** (limewater) turns milky/cloudy	 **ALLOW** any suitable named acid **REJECT** any other incorrect reagent for **M1** and **M2** **M2** dep on **M1** or mention of adding acid **ALLOW** white precipitate **M3** dep on limewater	3
			Total 11

Question number	Answer	Notes	Marks
7 (a)	An explanation that links the two points **M1** in solid sodium chloride ions are in a fixed position/in a lattice/cannot move **M2** when molten or in solution ions are free to move/flow	No marks if reference to electrons moving	2
(b) (i)	$2H_2O \rightarrow 4H^+ + (1)O_2 + 4e^-$	**ALLOW** multiples and fractions **IGNORE** state symbols even if incorrect	1
(ii)	chloride (ions)/(2)Cl^-/it lose electrons	**ALLOW** electrons are lost **REJECT** chlorine loses electrons	1
(c) (i)	(squeaky) pop with lighted splint	**REJECT** glowing splint	1
(ii)	An explanation that links any three of the following four points **M1** solution/water contains hydrogen ions/H^+ **M2** hydrogen ions/H^+ are attracted to the negative electrode/cathode **M3** hydrogen ions/H^+ gain electrons **M4** and (combine in pairs to) form hydrogen molecules/H_2	**IGNORE** sodium ions Can score M3 and M4 for fully correct half equation. i.e. $2H^+ + 2e \rightarrow H_2$	3
(d) (i)	**M1** $\sum$ bond energies on LHS = 2 × 436 + 498 **OR** 1370 (kJ) **M2** $\sum$ bond energies on RHS = 4 × 463 **OR** 1852 (kJ) **M3** (1370 − 1852) = −482 (kJ)	Correct answer without working scores 3 **ALLOW** ecf on **M1** and **M2** **ALLOW** −241 (kJ) (for 1 mole of water) for all 3 marks sign required to score **M3**	3

Question number	Answer	Notes	Marks
7 (d) (ii)	**M1** two horizontal lines in correct positions with products line to the right of reactants line **M2** horizontal lines labelled correctly with formulae of reactants and products **M3** vertical line in correct position and labelled Δ*H* $2H_2 + O_2$ ΔH $2H_2O$	**ALLOW** ecf on incorrect positive value for **M3** **ACCEPT** double headed arrow or arrow pointing from reactants level to products level **REJECT** arrow pointing from products level to reactants level **IGNORE** activation energy hump	3
			Total 14

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