Pearson
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Mark Scheme (Results)

Summer 2021

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1C and Science (Double Award) (4SD0) Paper 1C

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Summer 2021
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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.

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1 (a)</td><td>
<table>
<tr><th>Information</th><th>Substance</th></tr>
<tr><td>a good conductor of electricity</td><td>copper</td></tr>
<tr><td>an element that has a basic oxide</td><td>copper</td></tr>
<tr><td>a substance used as a fuel</td><td>methane</td></tr>
<tr><td>a major cause of acid rain</td><td>sulfur dioxide</td></tr>
<tr><td>a non-metallic element that is a solid at room temperature</td><td>iodine</td></tr>
</table>
</td><td>ALLOW correct formulae</td><td>5</td></tr>
<tr><td>(b)</td><td>A description which refers to the following points

M1 bubble/add (the gas/carbon dioxide) into limewater

M2 (limewater) turns cloudy/milky</td><td>ACCEPT calcium hydroxide

ACCEPT white precipitate

M2 dep on use of limewater/calcium hydroxide in M1</td><td>2

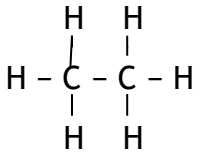
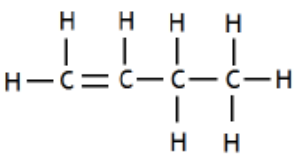
Total 7</td></tr>
</table>

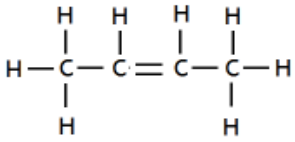
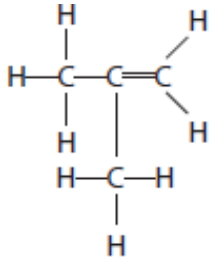
Question number	Answer	Notes	Marks
2 (a) (i)	<table><tr><th>Sub-atomic particle</th><th>Relative mass</th><th>Relative charge</th></tr><tr><td>electron</td><td>0.0005</td><td>−1</td></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr></table>	1 mark for each correct answer **ACCEPT** minus one **REJECT** – unqualified **ACCEPT** one **ALLOW** +1 **ACCEPT** zero/none/ no charge	3
(ii)	nucleus		1
(b) (i)	U		1
(ii)	25		1
(iii)	W		1
(iv)	Y and Z		1

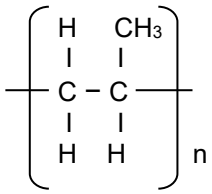
Question number	Answer	Notes	Marks
2 (c)	• sum of masses multiplied by percentages • division by 100 • answer given to 1 decimal place Example calculation **M1** (91.2 x 20) + (8.80 x 22) **OR** 2017.6 **M2** 2017.6 ÷ 100 **OR** 20.176 **M3** 20.2 **OR** answer from **M2** given to 1d.p.	Correct answer of 20.2 with or without working scores 3 **ACCEPT** 2018 **ACCEPT** 20.18 correct answer without working scores 3 20.176 and 20.18 without working score 2 2020 scores **M1** and **M3** 20 without working scores 0 20 with correct working scores 2	3 **Total 11**

Question number	Answer	Notes	Marks
3 (a) (i)	diffusion		1
(ii)	Any two from **M1** stir (the mixture) **M2** heat (the mixture) **M3** grind the sugar or break into smaller pieces or increase its surface area	**ALLOW** shake/swirl **ALLOW** any description of heating	2
(b) (i)	(simple) distillation	**REJECT** fractional distillation **ALLOW** distilling OWTTE	1
(ii)	An explanation that links the following two points **M1** (water/ vapour/ steam / gas) is cooled **M2** and condenses **OR** in the condenser		2
			Total 6

Question number	Answer	Notes	Marks
4 (a) (i)	A description including any three of the following **M1** pour some solvent into a beaker /chromatography tank **M2** place the paper in the solvent so that the food colourings are above the level of the solvent **M3** leave the paper until the solvent reaches the level shown in the diagram/ has moved to near the top of the paper OWTTE **M4** take the paper out and leave to dry	**M1** and **M2** can be scored from a labelled diagram **ALLOW** any named solvent	3
(ii)	one/1		1
(iii)	(F/it is) insoluble (in the solvent)/ does not dissolve (in the solvent)		1
(iv)	**M1** E and H **M2** they contain a dye that moved the furthest (distance up the paper)/ is closest to the solvent front / has the greatest R_f value	**M2** dep on **M1**	2
(b)	**M1** distance moved by solvent = 59-61mm **and** distance moved by the dye = 37-41mm **M2** distance moved by the dye ÷ distance moved by the solvent ≈ 0.67 **M3 (**the dye in food colouring) G	**ALLOW** distances in cm e.g. 6cm and 4cm If paper has been printed on A4 distances will be 51-53mm and 33-37mm **ALLOW** alternative methods	3
			Total 10

Question number	Answer	Notes	Marks
5 (a) (i)	<table><tr><td>molecular formula</td><td>C_2H_6</td></tr><tr><td>name</td><td>ethane</td></tr><tr><td>empirical formula</td><td>CH_3</td></tr><tr><td>displayed formula</td><td>  </td></tr></table>	Penalise incorrect use of case, superscripts	3
(ii)	**2**C_2H_6 + **7**O_2 → **4**CO_2 + **6**H_2O	**ACCEPT** multiples and fractions	1
(iii)	Any two from **M1** carbon monoxide/CO **M2** carbon/C **M3** water (vapour)/steam/H_2O	 **ALLOW** soot **IGNORE** carbon dioxide	2
(b) (i)	**A** addition B is incorrect as it is not a decomposition reaction C is incorrect as no solid precipitate is produced D is incorrect as it is not a substitution reaction		1
(ii)	Any two from **M1** 	Do not accept displayed formulae of cyclic alkanes	2

	M2  **M3** 	**ALLOW** cis-trans (E/Z) isomers of but-2-ene for both marks	
(iii)	isomers	**ALLOW** isomerism	1

Question number	Answer	Notes	Marks
5 (c) (i)	 **M1** correct repeat unit **M2** extension bonds, brackets and n after brackets	If double bond between carbon atoms scores 0	2
(ii)	A discussion which refers to the following points **M1** polymers/poly(propene) will remain in landfill indefinitely OWTTE **M2** (as they) are inert /unreactive/do not biodegrade **M3** burning produces toxic gases	**ALLOW** burning produces greenhouse gases	3
			Total 15

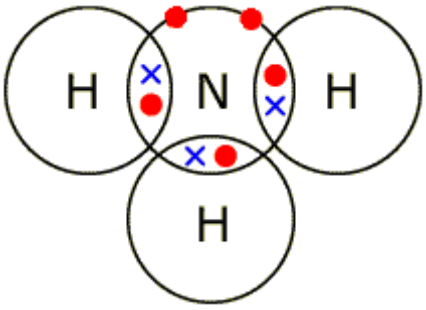
Question number	Answer	Notes	Marks
6 (a) (i)	Any 3 from **M1** effervescence/bubbles/fizzing **M2** moves **M3** floats **M4** disappears/gets smaller **M5** vapour trail/steam	 moves on surface scores **M2** and **M3** **ALLOW** dissolves **IGNORE** melts/heat produced **IGNORE** any reference to indicators	3
(ii)	An explanation that links the following two points **M1** the universal indicator turns purple/blue **M2** (because) OH^-/hydroxide ions are present	 **ALLOW** an alkaline solution /an alkali is produced / a solution of high pH is formed	2
(iii)	$2Li + 2H_2O \rightarrow 2LiOH + H_2$ **M1** all formulae correct **M2** balancing of correct formulae	**ALLOW** multiples and fractions **M2** dep on **M1**	2
(b) (i)	An explanation that links the following two points **M1** to remove any other ions/chemicals/ impurities/ contaminants/ compounds/substances (that may be on the wire) **M2** (so that) they do not interfere with/mask the colour of the flame	 **ALLOW** (so that) they do not affect the result (of the test) **ALLOW** (remove substances) that could colour the flame	2

(ii)	**D** yellow A is incorrect as sodium ions do not give a green flame B is incorrect as sodium ions do not give a lilac flame C is incorrect as sodium ions do not give a red flame		1

Question number	Answer	Notes	Marks
6 (c) (i)	K^+ and SO_4^{2-}		1
(ii)	An explanation that links the following four points **M1** (potassium sulfate) has a giant (ionic) structure /lattice **M2** electrostatic attraction between oppositely charged ions **M3** (ionic bonds or forces / attractions between ions) are strong **M4** a large amount of energy is needed to overcome the forces/break the bonds	ionic bonds are strong scores M3	4
			Total 15

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>7 (a) (i)</td><td>→ magnesium chloride + hydrogen</td><td>ACCEPT in either order</td><td>1</td></tr>
<tr><td>(b) (i)</td><td><table><tr><td>temperature of the acid at the start in °C</td><td>22.4</td></tr><tr><td>highest temperature reached in °C</td><td>43.2</td></tr><tr><td>temperature rise in °C</td><td>20.8</td></tr></table></td><td>ALLOW ECF from incorrect starting temperature</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
7 (ii)	• substitute correct values into $Q = mc\Delta T$ • evaluation Example calculation **M1** $Q = 25 \times 4.2 \times 20.8$ **M2** 2184 (J)	Correct answer of 2184 or 2194 without working scores 2 **ALLOW** 25.12g for m **ACCEPT** any number of sig figs except 1 **ALLOW** ECF from M1	2
(iii)	• find the amount of magnesium in moles • divide Q by n • convert answer in J/mol to kJ/mol • answer including sign Example calculation **M1** n(Mg) = 0.12 ÷ 24 **OR** 0.005(0) **M2** $Q \div n$ **OR** 2184 ÷ 0.005(0) **OR** 436,800 (J/mol) **M3** 436,800 ÷ 1000 **OR** 436.8 (kJ/mol) **M4** – 436.8 (kJ/mol)	 **ACCEPT** use of 2180 or 2200 **ALLOW** ECF on incorrect answer to (ii) and/or **M1** **ALLOW** ECF on incorrect answer to **M2** **ALLOW** ECF on incorrect answer to **M3** Correct answer with minus sign and without working scores 4 Correct answer without minus sign and without working scores 3 **ACCEPT** any number of sig figs except 1 throughout (ii) -438.8 or-438.9 also scores 4 (from 5.12g and 2194J in (ii))	4 **Total 9**

Question number	Answer	Notes	Marks
8 (a)	A description which refers to the following six points Test for ammonium ions: **M1** add sodium hydroxide (solution) (and warm) **M2** test the gas with (damp) (red) litmus paper/(damp) universal indicator paper **M3** (litmus) turns blue /(universal indicator) turns blue/purple (if ammonium ions are present) Test for sulfate ions: **M4** add (dilute hydrochloric/nitric) acid **M5** add barium chloride (solution) /barium nitrate (solution) **M6** white precipitate (if sulfate ions are present)	 **ALLOW** other alkalis No **M2** or **M3** if solution tested with litmus/ universal indicator paper **M4** and **M5** can be in either order No **M4** or **M6** if sulfuric acid added **M6** dep on **M5**	6
(b) (i)	neutralisation	**ALLOW** acid-base OR acid-alkali	1
(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	**ALLOW** multiples	1
(iii)	**M1** 3 bonding pairs correct **M2** rest of molecule correct  	 **M2** dep on **M1** **ALLOW** any combination of dots and crosses	2
			Total 10

Question number	Answer	Notes	Marks
9 (a) (i)	carbon dioxide/a gas is given off/escapes	**REJECT** incorrect gas	1
(ii)	to prevent acid/ liquid/ solution/ spray from leaving the flask OWTTE		1
(iii)	An explanation that links two of the following **M1** (insoluble) calcium sulfate will form **M2** which will form a coating/ layer on the marble chips **M3** slowing down/ preventing/ stopping the reaction	 M3 dep on M1 or M2	2
(b) (i)	An explanation that links the following four points **M1** the curve is steep(est) at the start **M2** because the (acid) concentration is high(est) **M3** the curve becomes less steep as the solution/ acid is becoming more dilute **M4** the curve levels off/ stops going up when the acid has all been used up **OR** **M1** the curve is steep(est) at the start **M2** because the reaction is fast(est) at the start **M3** the curve becomes less steep because the reaction slows down **M4** the curve levels off/stops going up when the acid has all been used up	 **ALLOW** there are the most (acid) particles in solution **ALLOW** the curve becomes less steep as there are fewer acid particles/particles in solution **IGNORE** references to particles of marble chips **IGNORE** references to energy	4

(ii)	M1 curve drawn starting at the origin and below the original curve M2 curve levels off at 0.27 g + or − half a small square		2

Question number	Answer	Notes	Marks
9 (c)	An explanation that links the following four points **M1** the rate of reaction increases/ the reaction is faster/ the reaction speeds up and any three from **M2** because the particles gain (kinetic) energy /move faster **M3** there are more collisions per unit time **M4** more collisions/particles have energy greater than the activation energy **M5** more collisions are successful	there are more frequent successful collisions scores **M3** and **M5**	4 **Total 14**

Question number	Answer	Notes	Marks
10 (a) (i)	so that the (hot) lead does not react with oxygen/air (converting back into lead oxide)	**ACCEPT** so that lead is not oxidised (back to lead oxide)	1
(ii)	M1 repeat the heating M2 until the mass remains constant/ does not change	**ACCEPT** heat to constant mass for both marks	2
(b) (i)	4.66 (g)		1
(ii)	0.48 (g)		1
(iii)	• calculate the moles of lead and oxygen • divide by the smaller number • calculate the whole number ratio • give the empirical formula Example calculation **M1** $\frac{4.66}{207}$ and $\frac{0.48}{16}$ **OR** 0.0225 and 0.03(00) **M2** $\frac{0.0225}{0.0225}$ and $\frac{0.03(00)}{0.0225}$ **OR** 1:1.33 **M3** 1 x 3 and 1.33 x 3 **OR** 3:4 **M4** Pb_3O_4	Division by atomic numbers or upside down calculation scores 0 3:4 ratio without working scores 3 Pb_3O_4 without working scores 4 **ALLOW** ECF from incorrect masses.	4

Question number	Answer	Notes	Marks
10 (c) (i)	$Pb(NO_3)_2$ (aq) + 2HCl (aq) → $PbCl_2$ (s) + 2HNO_3 (aq)	**ALLOW** any combination of uppercase and lowercase letters	1
(ii)	• calculate the amount of $PbCl_2$ • multiply the moles by the M_r of $PbCl_2$ • evaluation to show that the value is about 5 g Example calculation **M1** $n(PbCl_2) = \frac{0.0370}{2}$ **OR** 0.0185 (mol) **M2** mass of $PbCl_2$ = 0.0185 x 278 (g) **M3** 5.143 (g)	**MAX 1** for 0.0370 x 278 if no division by 2 in **M1** **ALLOW** any number of sig figs 5.1, 5.14 and 5.143 g without working score 3 5 g without working scores 0 **ALLOW** alternative methods	3
			Total 13

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