Mark Scheme (Results)

January 2023

Pearson Edexcel International GCSE in Chemistry (4CH1) Paper 1CR and Science (Doube Award) (4SD0) Paper 1CR

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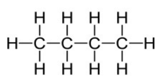
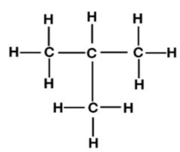
General Marking Guidance

- 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)	X evaporating Y condensing Z freezing	ALLOW evaporation ALLOW condensation	3
(b)	**M1** solid particles vibrate about a fixed position **M2** gas particles move randomly	REJECT do not move **ALLOW** gas particles move rapidly/quickly/freely	2 **Total 5**

Question number			Answer	Notes	Marks
2	(a)	(i)	nitrogen	**ALLOW** N_2 **IGNORE** N	1
		(ii)	argon	**ALLOW** Ar	1
		(iii)	carbon dioxide	**ALLOW** CO_2/$H_2O(g)$/water vapour/CH_4/methane	1
	(b)	(i)	brown/red-brown/orange-brown	**ALLOW** orange **IGNORE** red **ALLOW** rusty/rust coloured (looks like)rust/rusted	1
		(ii)	**M1** (change in length of column =) 84 – 69 **OR** 15 (mm) **M2** $\frac{15 \times 100}{84}$ = 17.86/17.9 (=18)	**M2** subsumes **M1** Working must be shown to score **M2** **Ecf for M2 eg 18/84 x100 =21.4** **REJECT** 17.85/17.8 as wrongly rounded	2
		(iii)	not all the oxygen in the sample of air had reacted with the iron wool OWTTE /not enough iron wool	**ALLOW** there is water vapour in the column of air/changes in temperature / pressure / location ALLOW Reaction incomplete/reaction too slow	1
					Total 7

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>3 (a)</td><td>
<table>
<tr><td>structural formula</td><td>$CH_3CH_2CH_2CH_3$</td></tr>
<tr><td>name</td><td>butane</td></tr>
<tr><td>molecular formula</td><td>C_4H_{10}</td></tr>
<tr><td>empirical formula</td><td>C_2H_5</td></tr>
<tr><td>general formula</td><td>C_nH_{2n+2}</td></tr>
</table>
1 mark for each correct answer</td><td></td><td>4</td></tr>
<tr><td>(b) (i)</td><td>M1 (compounds with the) same molecular formula

M2 (but with) different structural/displayed formulae</td><td>ALLOW same numbers of each atom
ALLOW different arrangement of atoms</td><td>2</td></tr>
<tr><td>(ii)</td><td>M1 displayed formula of butane

M2 displayed formula of methylpropane
</td><td></td><td>2</td></tr>
<tr><td>(c) (i)</td><td>HBr</td><td>REJECT incorrect case letters

Ignore name</td><td>1</td></tr>
<tr><td>(ii)</td><td>D substitution

A is incorrect as it is not an addition reaction
B is incorrect as it is not a decomposition reaction
C is incorrect as it is not a neutralisation reaction</td><td></td><td>1</td></tr>
<tr><td>(iii)</td><td>ultraviolet (radiation)</td><td>ACCEPT UV (radiation)

ALLOW ultraviolet/UV light/sunlight</td><td>1</td></tr>
<tr><td>(d) (i)</td><td>$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

M1 all formulae correct

M2 balancing of correct formulae</td><td>ALLOW multiples and fractions

M2 dep on M1</td><td>2</td></tr>
<tr><td>(ii)</td><td>An explanation that links the following points

M1 carbon monoxide/CO (is the gas produced)

M2 (carbon monoxide) limits the capacity of the blood/haemoglobin to carry oxygen OWTTE</td><td>

M2 dep on M1</td><td>2

Total 15</td></tr>
</table>

Question number			Answer	Notes	Marks
4	(a)		Any two from **M1** concentration of solution A **M2** concentration of solution B **M3** volume of solution B	ALLOW amount of solution B Ignore apparatus	2
	(b)	(i)	all points plotted correctly to the nearest grid line		1
		(ii)	anomalous point at 25°C circled	**ALLOW** ecf from incorrect plotting	1
		(iii)	smooth curve of best fit ignoring the anomalous point	ALLOW Ecf if 35,130 circled	1
		(iv)	Any one from **M1** temperature was higher than 25°C **M2** started the timer too late /stopped the timer too early/took reading too early	**ALLOW** ecf from incorrect anomalous result circled so 35,130 gives slower as temp<35/timer stopped too late	1
		(v)	**M1** vertical line on graph drawn to curve from 55°C **M2** value obtained from candidate's graph	ALLOW extra point at 55°C on curve expected value 115 to 117 s	2
	(c)		**M1** $\frac{1}{156}$ **OR** 0.00641 **M2** 6.41×10^{-3}	**ALLOW** use of value from graph ALLOW 6.4×10^{-3}	2
	(d)		An explanation that links the following three points **M1** rate (of reaction) increases **M2** (mean) kinetic energy of particles increases **M3** more successful collisions per second/unit time/ more frequent successful collisions	**ALLOW** reaction is faster/ speeds up **ALLOW** particles move faster **IGNORE** vibrate more /faster **ALLOW** more frequent collisions having energy $\geq$ activation energy	3 **Total 13**

Question number	Answer	Notes	Marks
5 (a) (i)	5/five		1
(ii)	46		1
(iii)	**M1** hydrocarbons contain only carbon and hydrogen (atoms) **M2** methanoic acid/it contains oxygen (as well as hydrogen and carbon)	REJECT molecules	2
(b) (i)	**M1** (electrostatic) attraction between nuclei **M2** (and the) shared pair of electrons OR M1 (electrostatic) attraction between shared pair(s) of electrons M2 and nuclei	Must be plural Must be plural	2
(ii)	**M1** 3 pairs of electrons for 3 single bonds **M2** 2 shared pairs for one C=O double bond **M3** rest of molecule fully correct (lone pairs on oxygen atoms must be shown)	**ALLOW** any combination of dots and crosses **M3** dep on **M1** and **M2** correct	3
(c)	• divide percentages by relative atomic masses • divide results by smallest value to obtain ratio • write empirical formula Example calculation **M1** C: $\frac{52.2}{12}$ H: $\frac{13.0}{1}$ O: $\frac{34.8}{16}$ **M2** $\frac{4.35}{2.175}$ $\frac{13.0}{2.175}$ $\frac{2.175}{2.175}$ **OR** 2 6 1 **M3** C_2H_6O	0 marks if division by atomic numbers or upside-down calculation **ACCEPT** symbols in any order	3 **Total 12**

Question number	Answer	Notes	Marks
6 (a) (i)	**B** bromine A is incorrect as astatine is a solid at room temperature C is incorrect as chlorine is a gas at room temperature D is incorrect as fluorine is a gas at room temperature		1
(ii)	**C** dark grey A is incorrect as solid iodine is not black B is incorrect as solid iodine is not dark brown D is incorrect as solid iodine is not purple		1
(iii)	**M1** test with (damp blue) litmus paper **M2** bleaches/turns white	ALLOW Universal indicator paper/ pH paper **ACCEPT** turns red and then bleaches	2
(b)	**M1** 71.2 x 35 + 28.8 x 37 **OR** 3557.6 **M2** $\frac{71.2 \times 35 + 28.8 \times 37}{100}$ **OR** $\frac{3557.6}{100}$ **OR** 35.576 **M3** 35.6	Correct answer without working scores 3 **M2** subsumes **M1** 35.5 without working scores 0	3
(c)	An explanation that links the following four points **M1** add chlorine (solution) to sodium iodide (solution) **M2** solution turns brown **M3** iodine/I_2 is displaced **M4** (so) chlorine is more reactive (than iodine) ORA	**ALLOW** mix the two solutions **ALLOW** iodine/I_2 is formed **REJECT** incorrect use of iodide or chloride once only	4 **Total 11**

Question number	Answer	Notes	Marks
7 (a)	**M1** (bright) white flame/light **M2** white powder/solid (formed)	 **ALLOW** white smoke/ash **ALLOW** grey powder **REJECT** white precipitate	2
(b) (i)	gives out/releases heat (energy)/thermal energy	**IGNORE** energy alone	1
(ii)	$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$	**ALLOW** multiples and fractions	1
(iii)	An explanation that links two of the following pairs of points **M1** aluminium/Al gains oxygen so is oxidised **M2** iron oxide/Fe_2O_3 loses oxygen so is reduced **OR** **M1** aluminium/Al is oxidised and iron oxide/Fe_2O_3 is reduced **M2** as aluminium/Al gains oxygen and iron oxide /Fe_2O_3 loses oxygen	 **ACCEPT** aluminium loses electrons so is oxidised **ACCEPT** iron ions/Fe^{3+} ions gain electrons so are reduced **ACCEPT** aluminium loses electrons and iron ions/Fe^{3+} ions gain electrons **ALLOW** answers in terms of change in oxidation number	2
(c) (i)	An explanation that links the following two points **M1** to allow air/oxygen to enter the crucible OWTTE **M2** so that oxygen can react with the magnesium		2
(ii)	A description that refers to the following points **M1** heat the crucible again and reweigh **M2** repeat until constant mass	Heat and reweigh to constant mass scores 2	2 **Total 10**

Question number	Answer	Notes	Marks
8 (a) (i)	(thermal) decomposition		1
(ii)	**M1** amount of $PbCO_3 = \frac{5.34}{267} = 0.02(00)$ (mol) **M2** mass of PbO = 0.02(00) x 223 = 4.46 (g)	Correct answer without working scores 2 **ACCEPT** alternative methods	2
(b) (i)	**M1** diagram showing delivery tube going into test tube containing liquid **M2** limewater labelled	REJECT if sealed with a bung	2
(ii)	(limewater) turns cloudy/milky	**ALLOW** white precipitate (ii) dep on mention of limewater in either (i) or (ii)	1
(c)	An explanation that links six of the following points **M1** silicon dioxide has a giant (covalent) structure **M2** covalent bonds are (very) strong **M3** (in silicon dioxide) many covalent bonds need to be broken **M4** a large amount of energy/more energy is required to break the bonds in silicon dioxide **M5** carbon dioxide has a simple molecular structure/is a simple molecule **M6** the forces between the molecules/intermolecular forces (in carbon dioxide) are weak **M7** very little energy/less energy is needed to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)	No **M3 or M4** if reference to intermolecular forces in silicon dioxide No **M6 or M7** if any reference to weak covalent bonds or breaking of covalent bonds in carbon dioxide Accept bonds between molecules weak A statement such as 'more energy is needed to break the bonds in silicon dioxide than to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)' scores **M4** and **M7**	6 **Total 12**

Question number	Answer	Notes	Marks
9 (a) (i)	$Zn(s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$	**ACCEPT** upper case letters	1
(ii)	effervescence/bubbles/fizzing	**IGNORE** gas produced /given off **IGNORE** hydrogen produced / given off **ALLOW** colourless solution formed/gets hot/exothermic reaction/zinc dissolves IGNORE crystals form	1
(b) (i)	so all the nitric acid reacts/is neutralised		1
(ii)	A description which refers to the following five points M1 filter off the excess zinc M2 heat the solution until crystals form M3 leave the solution to cool (and crystallise) M4 pour/filter off excess liquid (to obtain crystals) M5 leave (crystals) to dry	ALLOW heat until the solution is saturated/ heat until crystals form on the end of a glass rod/heat to evaporate some of the water IGNORE washing ALLOW any method of drying that avoids excess heat e.g. filter paper, a desiccator, a warm oven If heated to dryness only M1 can be scored If solution is not heated only M1, M4 and M5 can be scored	5
(c)	$2Zn(NO_3)_2.6H_2O \rightarrow 2ZnO + 4NO_2 + O_2 + 12H_2O$ **M1** all formulae correct **M2** balancing of correct formulae	**M2** dep on **M1**	2
			Total 10

Question number			Answer	Notes	Marks
10	(a)		**M1** so that the solid/ammonium nitrate dissolves more quickly **M2** so that the temperature is even throughout the solution OWTTE	IGNORE speed up reaction ALLOW heat transfers evenly (throughout the solution)	2
	(b)		initial temperature of distilled water in °C: 23.4 minimum temperature of solution in °C: 19.4 temperature change in °C: 4.0	must be to 1 dp **ALLOW** ecf on incorrect mimimum temperature	2
	(c)	(i)	**M1** (Q =) 50 x 4.2 x 3.9 (J) **M2** (Q =) 819/820 (J)	answer of 819 or 820 without working scores 2 **ALLOW** use of 4.0 giving an answer of 840	2
		(ii)	• find moles of NH_4NO_3 • division of Q by moles • conversion to kJ/mol • answer with correct sign **M1** (amount of NH_4NO_3 =) 2.8 ÷ 80 **OR** 0.035 (mol) **M2** 819 ÷ 0.035 **OR** 23 400 (J/mol) **M3** 23 400 ÷ 1000 **OR** 23.4 (kJ/mol) **M4** (ΔH =) +23.4/+23 (kJ/mol)	correct answer without working scores 4 use of 820 gives 23 429 use of 800 gives 22 857 use of 840 gives 24 000 use of 820 gives 23.4 use of 800 gives 22.9 use of 840 gives 24.0	4
	(d)		A description that refers to the following points **M1** add sodium hydroxide (solution to the ammonium nitrate and warm) **M2** test the gas/ammonia evolved with (damp) red litmus paper/(damp) universal indicator paper **M3** (red litmus) turns blue/ (universal indicator) turns blue/purple	**M2** and **M3** dep on **M1** No **M2** or **M3** if solution tested with litmus/ universal indicator paper	3

(e)	An explanation that links the following points **M1** the temperature increases/rises **M2** so the reaction is exothermic		2 **Total 15**

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