



Mark Scheme (Results)

Summer 2024

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

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General Marking Guidance

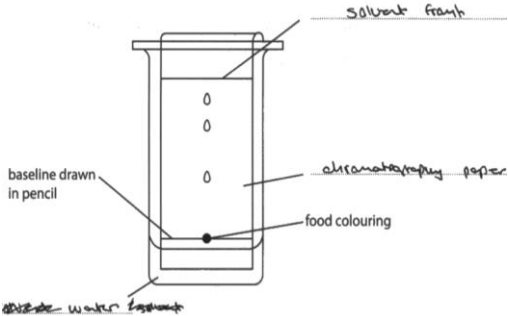
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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) (i)	W		1
(ii)	V		1
(iii)	Z		1
(b) (i)	the number of protons (in the nucleus)	IGNORE reference to electrons ALLOW amount of protons	1
(ii)	(the sum of) the number of protons and neutrons (in the nucleus)	ALLOW amount of protons and neutrons	1
total for question = 5			

Question number	Answer	Notes	Marks
2 (a)	oxygen	ALLOW O ₂	1
(b)	M1 carbon dioxide / CO ₂ M2 water / H ₂ O	answers can be in either order ACCEPT water vapour ALLOW steam	2
(c) (i)	there is a limited supply of air / oxygen OWTTE	ALLOW not enough air/oxygen	1
(ii)	carbon monoxide reduces the capacity of blood to transport oxygen OWTTE	ACCEPT correct references to haemoglobin ALLOW produces carboxyhaemoglobin	1
(d)	substitution	ALLOW redox (reaction)	1
total for question = 6			

Question number	Answer	Notes	Marks
3 (a)	(i) filtration		1
	(ii) fractional distillation		1
(b)	M1 (two) different atoms / elements M2 joined / bonded together	ACCEPT atoms/elements of silicon and oxygen REJECT M2 intermolecular forces / ionic bonds	2
(c)	(i) 5 / five		1
	(ii) 788		1
(d)	M1 $(3 \div 18) \times 100$ M2 16.7%	ALLOW ecf from M1 e.g. $(3 \div 15) \times 100 = 20\%$ scores 1 mark ALLOW 2 or more sig figs as long as a percentage sum and correctly rounded.	2
total for question = 8			

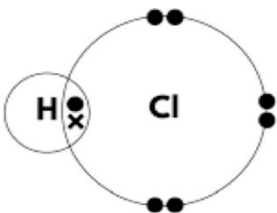
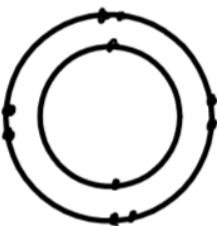
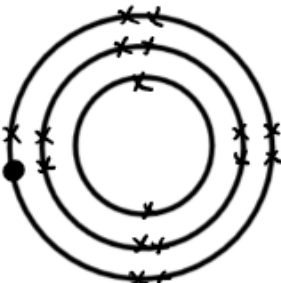
Question number	Answer	Notes	Marks
4 (a)	any two from: M1 floats M2 moves M3 melts / turns into a ball / sphere M4 gets smaller / disappears M5 white trail	M1 and M2 moves on the surface ALLOW sodium dissolves IGNORE effervescence / bubbling / fizzing	2
(b)	M1 do a flame test M2 yellow (flame)	ALLOW a description of the flame test ALLOW orange (flame)	2
(c) (i)	(they have the) same number of outer shell electrons / one outer shell electron		1
(ii)	as the atomic radius increases they get more reactive OWTTE		1
total for question = 6			

Question number	Answer	Notes	Marks
5 (a) (i)	<p>clockwise from bottom left</p> <p>M1 solvent</p> <p>M2 solvent front</p> <p>M3 chromatography paper</p>  <p>Diagram 1</p>	<p>ALLOW water</p> <p>ALLOW paper</p> <p>ALLOW chromatogram</p>	3
(ii)	pencil is not soluble / insoluble	<p>ACCEPT pencil will not dissolve</p> <p>ALLOW pencil will not run (up the chromatogram)</p>	1
(b) (i)	<p>B (W and Y)</p> <p>A is not the correct answer because W and X do not have a spot at the same height</p> <p>C is not the correct answer because X and Z do not have a spot at the same height</p> <p>D is not the correct answer because Y and Z do not have a spot at the same height</p>		1
(ii)	<p>M1 distance moved by the dye from 1.1 to 1.4 (cm) distance moved by the solvent 6.5 (cm)</p> <p>M2 distance moved by the dye ÷ distance moved by the solvent and correctly evaluated</p>	<p>e.g. 0.17 / 0.18 / 0.2(0) / 0.22</p> <p>ALLOW any number of sig figs as long as it is correctly rounded.</p> <p>ALLOW ECF from M1</p>	2
total for question = 7			

Question number	Answer	Notes	Marks
6 (a)	M1 (a substance/a fuel that) when burned M2 releases heat (energy) / thermal energy	ALLOW burns / combusts / catches fire	2
(b)	(i) temperature at the start = 20.4 °C highest temperature reached = 77.6 °C	ALLOW ECF from incorrect temperature reading	2
	(ii) M1 $150 \times 4.2 \times 57.2$ M2 36 036 (J)	ALLOW 36 000 if M1 is scored 36 036 with no working scores 2 ALLOW ECF from M1 as long as the 3 values are multiplied	2
	(iii) M1 36.036 kJ M2 amount of ethanol = $2.3 \div 46$ OR 0.05 (mol) M3 $36.036 \div 0.05$ OR 720.720 (kJ) OR M3 $36036 \div 0.05$ (J) M4 -720 (kJ/mol)	ALLOW 36 kJ M3 subsumes M1 and M2 ALLOW M3 to 2 sig figs ALLOW ECF M4 with 2 sig figs and a - sign Correct answer without working scores 4 marks	4
(c)	any one from heat absorbed by the metal can incomplete combustion heat lost to the surroundings	ALLOW heat loss	1
total for question = 11			

Question number	Answer	Notes	Marks
7 (a)	(i) measuring cylinder	ALLOW burette / pipette / syringe REJECT gas syringe	1
	(ii) (the) zinc / Zn / it is in excess		1
	(iii) so as little gas as possible is lost	ACCEPT to keep as much gas as possible ALLOW to avoid loss of gas / so gas does not escape	1
	(iv) any one from no further effervescence / bubbles / fizzing no more gas collects in the syringe	ALLOW gas syringe does not move	1
(b)	(i) M1 calculation of gradient OR $50 \div 150$ M2 0.33 M3 units cm^3/s	triangle needs to be drawn on graph for M1 ALLOW ECF from M1 ACCEPT $\text{cm}^3 \text{s}^{-1}$	3
	(ii) from 0 to 60 s M1 gradient is steepest M2 because there are most acid particles (per unit volume) / most collisions (per unit time) / most frequent collisions from 60 to 150 s M3 the curve becomes less steep M4 because there are fewer particles (per unit volume) / fewer collisions (per unit time) / fewer frequent collisions from 150 to 240 s M5 the reaction has stopped / curve levels off/becomes flat/plateaus M6 because the (sulfuric) acid has been used up	ACCEPT because concentration is greatest / highest ACCEPT because concentration is lower ALLOW the volume of gas becomes constant	6
total for question = 13			

Question number	Answer	Notes	Marks
8 (a)	<p>a description that links any 4 of the following points</p> <p>M1 crude oil is heated / vapourised</p> <p>M2 the vapour enters the lower part / bottom of the column</p> <p>M3 there is a temperature gradient in the column</p> <p>M4 the vapours rise up the column until they condense</p> <p>M5 at a height where the boiling point of the vapour is lower than the temperature in the column</p>	<p>ALLOW boiled</p> <p>ACCEPT cooler at the top and hotter at the bottom</p> <p>ALLOW the fractions are separated according to their boiling point</p>	4
(b)	<p>an explanation that links any 4 of the following points</p> <p>M1 fractional distillation of crude oil produces more long chain hydrocarbons than can be used directly</p> <p>M2 (cracking) produces shorter (chain) alkanes</p> <p>M3 which are more flammable/ more useful as fuels</p> <p>M4 (cracking) produces alkenes</p> <p>M5 which are used to make polymers/plastics</p>	<p>ALLOW is a lower demand for long chain hydrocarbons / a higher demand for short chain hydrocarbons</p> <p>ALLOW petrol / gasoline</p> <p>M3 dep on M2</p> <p>M5 dep on M4</p>	4
(c)	<p>M1 fuels contain sulfur</p> <p>M2 which burns producing sulfur dioxide</p> <p>M3 causing acid rain</p>	<p>IGNORE C / CO / CO₂ and any reference to global warming etc.</p> <p>REJECT nitrogen for M1</p> <p>ALLOW effects of acid rain</p> <p>M3 dep on M1 or M2 or NO₂ or SO₃</p>	3
total for question = 11			

Question number	Answer	Notes	Marks
9 (a) (i)	M1 NaCl M2 ZnO M3 (NH ₄) ₂ SO ₄	ACCEPT Na ⁺ Cl ⁻ / ClNa ACCEPT Zn ²⁺ O ²⁻ / OZn ACCEPT (NH ₄ ⁺) ₂ SO ₄ ²⁻ / SO ₄ (NH ₄) ₂ REJECT any incorrect charges Penalise once only for incorrect case or subscripts / superscripts	3
(ii)	zinc sulfate		1
(b) (i)	M1 2 bonding electrons M2 rest of the molecule correct 	ALLOW dots, crosses or any combination M2 dep on M1	2
(ii)	M1 magnesium ion  M2 chloride ion  M3 Mg ²⁺ and Cl ⁻	ALLOW dots, crosses or any combination Only 1 mark max in M1 and M2 if they only show the outer electrons, as the question requires the electronic configurations	3

(iii)	<p>An explanation that links any 5 of the following points</p> <p>M1 hydrogen chloride is simple molecular / simple covalent</p> <p>M2 magnesium chloride is giant ionic / ionic lattice</p> <p>M3 strong electrostatic attraction between (oppositely charged) ions</p> <p>M4 in hydrogen chloride there are weak intermolecular forces / weak forces between molecules</p> <p>M5 (much) more energy is required to break the (ionic) bonds in MgCl_2 than to overcome the (intermolecular) forces in HCl</p>	<p>ALLOW molecular covalent</p> <p>ALLOW giant structure if ions are mentioned</p> <p>ALLOW strong ionic bonds</p> <p>No M3 if any mention of covalent bonds or intermolecular forces in magnesium chloride</p> <p>REJECT weak forces between bonds</p> <p>REJECT any reference to breaking covalent bonds in HCl or MgCl_2</p>	5
total for question = 14			

Question number	Answer	Notes	Marks
10 (a)	<p>M1 a catalyst provides an alternative pathway / route</p> <p>M2 of lower activation energy</p>		2
(b) (i)	conical flask	ALLOW flask	1
(ii)	<p>M1 filter out the manganese(IV) oxide</p> <p>M2 allow it to dry</p> <p>M3 reweigh the catalyst, the same mass should be left / mass is still 1 g</p>		3
total for question = 6			

Question number	Answer	Notes	Marks
11 (a)	has only one type of atom	ACCEPT only made up of carbon atoms	1
(b)	M1 (attraction between) a shared pair of electrons M2 and nuclei OR M1 a shared pair of electrons M2 and (attraction between) nuclei	do not accept nucleus nuclei must be plural do not accept nucleus nuclei must be plural	2
(c) (i)	M1 delocalised electrons M2 (electrons) can move / flow (throughout the structure)	No marks if mention of ions / molecules in graphite	2
(ii)	M1 (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons M2 in diamond, the bonds need a lot of energy to break M3 (graphite is soft because) it has layers M4 which can slide over one another	ALLOW 3D/ rigid/ tetrahedral structure REJECT mention of intermolecular forces in diamond for M1 and M2 ALLOW sheets IGNORE intermolecular forces in graphite M4 dep on M3	4
(d)	M1 calculation M_r of C_x M2 $M_r \div 12$ M3 answer given as an integer exemplar M1 $1.40 \times 10^{-21} \times 6.02 \times 10^{23}$ OR 842.8 M2 $842.8 \div 12$ (= 70.23) M3 70	ALLOW any number of significant figures from 2 ALLOW ECF if division by atomic number 6 Answer of 70 without working scores 3	3
total for question = 12			

Question number	Answer	Notes	Marks
12 (a)	$2\text{TaCl}_5(\text{s}) + 5\text{H}_2(\text{g}) \rightarrow 2\text{Ta}(\text{s}) + 10\text{HCl}(\text{g})$	ALLOW multiples or fractions	1
(b) (i)	the last (3) masses are the same	ALLOW mass does not change / mass becomes constant	1
(ii)	<p>M1 mass of chlorine = 1243 (kg)</p> <p>M2 $1\,267\,000 \div 181$ and $1\,243\,000 \div 35.5$</p> <p>M3 7000 moles of tantalum and 35 014 moles of chlorine (so 1:5 ratio)</p>	<p>ALLOW calculation done in kilomoles e.g. $1267 \div 181$ and $1243 \div 35.5$</p> <p>e.g. ratio 7 : 35 moles</p> <p>M3 subsumes M1 and M2</p> <p>no M2 or M3 for upside down calculation or use of atomic numbers</p>	3
(c) (i)	<p>M1 carbon is oxidised and tantalum oxide is reduced</p> <p>M2 carbon gains oxygen and tantalum oxide loses oxygen</p> <p>OR</p> <p>M1 carbon gains oxygen and is oxidised</p> <p>M2 tantalum oxide loses oxygen and is reduced</p>	<p>Penalise tantalum is reduced or tantalum loses oxygen once only</p> <p>REJECT tantalum loses oxygen and is reduced</p> <p>ALLOW correct symbols and formulae throughout</p> <p>ACCEPT correct changes in oxidation numbers</p>	2

(ii)	<p>M1 ($5 \times 2000 =$) 10 000 moles of carbon is needed</p> <p>M2 ($10\,000 \times 12 =$) 120 000 g of carbon is needed (which is less than 500 000 g)</p> <p>OR</p> <p>M1 ($500\,000 \div 12$) of carbon is 41 667 moles</p> <p>M2 which is enough to react with ($41\,667 \div 5 =$) 8333 moles of tantalum oxide</p> <p>OR</p> <p>M1 ($5 \times 2000 =$) 10 000 moles of carbon is needed</p> <p>M2 ($500\,000 \div 12$) is more than 41 667 moles of carbon</p>	<p>($12 \times 2000 =$) 24 000 g</p> <p>($5 \times 24\,000 =$) 120 000 g of carbon is needed</p> <p>($500\,000 \div 5$) is 100 000 g</p> <p>which is enough to react with ($100\,000 \div 12 =$) 8333 moles of tantalum oxide</p>	2
	<p>(iii) M1 ($2 \times 2000 =$) 4000 moles of tantalum</p> <p>M2 ($4000 \times 181 =$) 724 000 g of tantalum</p>	<p>ALLOW ECF for incorrect moles e.g. $2000 \times 181 = 362\,000$ scores 1 $1000 \times 181 = 181\,000$ scores 1 $4000 \times 362 = 1\,448\,000$ scores 1</p>	2
total for question = 11			

