



Mark Scheme (Results)

November 2023

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 1C and Science
Double Award (4SD0) 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)	Four more particles (randomly spaced and) far apart	IGNORE any lines or arrows ACCEPT more than four particles as long as they are far apart REJECT any particles touching	1 GR
(b)	An explanation that links the following two points M1 (mean kinetic) energy of particles increases M2 more particles have enough energy to escape /more particles overcome the (intermolecular) forces (of attraction) holding them together	ALLOW particles move faster/more quickly IGNORE particles vibrate more IGNORE it has more energy/ heat energy increases ALLOW particles escape more quickly/more easily IGNORE more collisions REJECT breaking of bonds ALLOW molecules /atoms for particles in M1 and M2	2 EXP
(c) (i)	condensation/condensing		1 CL
(ii)	$\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$	ACCEPT multiples Formula must be correct ALLOW steam(g) → water(l) water(g) → water(l) Water vapour(g) →water(l) ALLOW upper case letters for state symbols Ignore missing brackets	1 GR
(d)	M1 <u>regular</u> arrangement of particles/particles closely packed M2 (particles) vibrate around a fixed position/vibrate only	ALLOW particles in a <u>regular</u> lattice	2 EXP
			Total 7

Question number	Answer	Notes	Marks												
2 (a)	<table border="1"> <tr> <td></td><td>Electron</td><td>Proton</td><td>Neutron</td></tr> <tr> <td>Relative mass</td><td>0.0005</td><td>1</td><td>1</td></tr> <tr> <td>Relative charge</td><td>-1</td><td>+1</td><td>0</td></tr> </table> ALLOW - +		Electron	Proton	Neutron	Relative mass	0.0005	1	1	Relative charge	-1	+1	0	All 4 correct 2 marks 2 or 3 correct 1 mark	2
	Electron	Proton	Neutron												
Relative mass	0.0005	1	1												
Relative charge	-1	+1	0												
(b) (i)	B (3) A is incorrect as 2 is not the atomic number of P C is incorrect as 4 is not the atomic number of P D is incorrect as 7 is the mass number of P		1												
(ii)	B (16) A is incorrect as 8 is the atomic number of U C is incorrect as 18 is not the mass number of U D is incorrect as 26 is not the mass number of U		1												
(iii)	S	ALLOW nitrogen/N/N ₂	1												
(c) (i)	An explanation that links the following two points M1 (Q and R have) same number of protons/ both have 5 protons M2 (but) different numbers of neutrons/ (Q has) 5 neutrons and (R has) 6 neutrons/R has an extra neutron	IGNORE same number of electrons IGNORE references to atomic and mass numbers	2												
(ii)	M1 $20.6 \times 10 + 79.4 \times 11$ OR 1079.4 M2 $\frac{20.6 \times 10 + 79.4 \times 11}{100}$ OR $\frac{1079.4}{100}$ OR 10.794 M3 10.8	ALLOW ecf if incorrect mass numbers used 10.8 without working scores 3 10.79/10.794 without working scores 2 Use of 5 and 6 = 5.8 scores 2 Use of 15 and 16 = 15.8 scores 2 Use of 5 and 5 = 5.0 scores 1	3												
			Total 10												

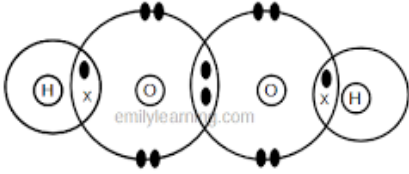
Question number	Answer	Notes	Marks
3 (a)	(i) fractional distillation	ALLOW fractionating	1
	(ii) (crude oil/it is) heated / vapourised/ boiled	Ignore evaporated	1
	(iii) E	ALLOW gasoline/petrol	1
	(iv) kerosene	ALLOW paraffin	1
	(v) (Fuel) for ships	ALLOW any acceptable use of fuel oil eg home heating, industrial heating, electricity generation, power station, furnaces for metal smelting, feedstock for plastics/fertilisers	1
(b)	An explanation that links the following three points M1 B has longer chain/molecules ORA M2 B has stronger intermolecular forces/bonds Forces/bonds between molecules ORA M3 more energy is needed to overcome the (intermolecular) forces/intermolecular bonds separate the molecules ORA	ALLOW B has larger/bigger/longer chain/ molecule/hydrocarbon ALLOW molecule/hydrocarbon with greater mass ALLOW more intermolecular forces/ bonds REJECT IMF between atoms No M2 or M3 if any reference to breaking of covalent bonds	3
(c)	(i) silica / alumina (catalyst)	ACCEPT SiO ₂ /Al ₂ O ₃ /silicon dioxide /aluminium oxide /aluminosilicates /zeolites	1
	(ii) Any one of the following two pairs		2
	M1 C₂H₄ and M2 C₅H₁₀ OR M1 C₃H₆ and M2 C₄H₈	If the equation does not balance allow 1 mark for a correct formula of an alkene	
	(iii) (to make) polymers /polymerisation	ACCEPT the name of a correct addition polymer eg polyethene, polypropene etc. ACCEPT to make alcohol(s) Reject fuels	1
			Total 12

Question number	Answer	Notes	Marks
4 (a) (i)	nitrogen	ALLOW N ₂	1
(ii)	carbon dioxide	ALLOW CO ₂	1
(iii)	argon	ALLOW Ar	1
(iv)	hydrogen	ALLOW H ₂	1
(v)	carbon dioxide	ALLOW CO ₂	1
(vi)	(12 + 2 × 16 =) 44		1
(vii)	air is a mixture (of gases) / does not have a formula / does not have an M _r OWTTE		1
(b) (i)	(thermal) decomposition		1
(ii)	M1 green M2 (to) black	Mark independently colours must be in the correct order	2
(iii)	CuCO ₃ → CuO + CO ₂	ALLOW multiples and fractions IGNORE state symbols even if incorrect	1
			Total 11

Question number	Answer	Notes	Marks
5 (a) (i)	M1 (compounds with) same molecular formula M2 different structural/displayed formulae	IGNORE general formula/chemical formula ALLOW different structures/arrangement of atoms	2
(ii)	M1 displayed formula of butane <pre> H H H H H — C — C — C — C — H H H H H </pre> M2 displayed formula of methylpropane <pre> H H H H — C — C — C — H H C H H </pre>	REJECT molecular formula in structure Accept either order	2
(b) (i)	ultraviolet/UV (radiation)	ALLOW ultraviolet/UV light/rays	1
(ii)	$\text{C}_2\text{H}_6 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_5\text{Br} + \text{HBr}$	ALLOW multiple substitutions as long as the equation is balanced	1
(iii)	Substitution		1
(c)	An explanation that links the following two points M1 (has) <u>all</u> single bonds/<u>only</u> single bonds/ (has) no double/multiple bonds M2 (so) no other atoms can be added (to ethane)/no addition reactions	ALLOW contains the maximum number of hydrogen atoms /each carbon bonded to four hydrogen atoms ALLOW only undergoes substitution reactions	2
(d)	M1 with ethane bromine water stays orange/yellow M2 with ethene bromine water changes (from orange/yellow) to colourless/ is decolourised	ALLOW no (colour) change /not decolourised IGNORE no reaction ,no observation IGNORE brown REJECT any other colour IGNORE brown REJECT any other colour	2

(e)	An explanation that links the following three points M1 there are twice as many H atoms as C atoms in alkenes OR general formula of alkenes is C_nH_{2n} M2 (so alkenes) empirical formula is always CH_2 M3 (alkanes) empirical formula of C_2H_6 is CH_3 and empirical formula of C_4H_{10} is C_2H_5 (shows they are different) Alkanes general formula is C_nH_{2n+2} so can't divide by n	ALLOW examples of any two from C_2H_4 C_3H_6 C_4H_8	3
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(f)	M1 $\frac{19.2}{12}$ $\frac{4.0}{1}$ $\frac{12.8}{16}$ $\frac{64.0}{80}$ M2 $\frac{1.6}{0.8}$ $\frac{4.0}{0.8}$ $\frac{0.8}{0.8}$ $\frac{0.8}{0.8}$ OR 2 5 1 1 M3 C_2H_5OBr	0 marks for upside down calculation or use of atomic numbers Ecf on incorrect atomic mass but can't be an atomic number 6,8 or 35 Symbols can be in any order correct answer without working scores 3	3
			Total 17

Question number	Answer	Notes	Marks
6 (a)	Relights/ignites a glowing splint/spill		1
(b)	M1 3 bond pairs correct M2 rest of molecule fully correct Eg.  Symbols X: electron of H •: electron of O	ALLOW any combination of dots and crosses M2 dep on M1	2
(c) (i)	all points plotted correctly to the nearest grid line (+-1/2 small square)		1
(ii)	best fit curve starting at 0 and levelling off at 94 cm ³	Ecf possible from misplotted point	1
(d) (i)	An explanation that links the following three points M1 fewer particles (in the same volume) M2 fewer collisions per unit time/less frequent collisions M3 (so) rate of reaction decreases	REJECT if reference to less/more kinetic energy/less movement IGNORE less chance of collisions REJECT if reference to less/more kinetic energy/less movement MAX 1 mark can be awarded here If kinetic energy/particle movement mentioned in answer	3
(ii)	M1 curve starting at 0 and less steep than original curve M2 curve levelling off at 46-48 cm³ inclusive		2
(e)	An explanation that links the following two points M1 provides an alternative pathway/route M2 with lower activation energy		2
			Total 12

Question number	Answer	Notes	Marks
7 (a)	A description that refers to the following six points M1 add sodium hydroxide (solution) M2 if a green precipitate forms it is an iron(II)/Fe²⁺ compound M3 if a brown precipitate forms it is an iron(III)/Fe³⁺ compound M4 add silver nitrate (solution to a fresh sample) M5 if cream precipitate forms it is a bromide/Br⁻ M6 if white precipitate forms it is a chloride/Cl⁻	ALLOW add (aqueous) ammonia M2 and M3 dep on M1 ALLOW red-brown/orange-brown precipitate IGNORE addition of nitric acid REJECT addition of hydrochloric or sulfuric acid for M4 M5 and M6 dep on addition of silver nitrate	6
(b)	M1 moles of iron = $2.8 \div 56 = 0.05(0)$ M2 2 mol iron reacts with 3 mol chlorine M3 moles of Fe to react with Cl₂ = $\frac{0.060 \times 2}{3} = 0.04(0)$ (so iron is in excess) OR M2 2 mol iron reacts with 3 mol chlorine/ 3 mol chlorine reacts with 2 mol iron M3 moles of Fe to react with Cl₂ = $\frac{0.060 \times 2}{3} = 0.04(0)$ M4 $0.04(0) \times 56 = 2.24$ g (so iron is in excess) OR M1 moles of iron = $2.8 \div 56 = 0.05(0)$ M2,M3 moles of Cl₂ to react with Fe = $\frac{0.05(0) \times 3}{2} = 0.075$ (so 0.060 moles is not enough, so iron is in excess)	MAXIMUM 3 MARKS	3
(c) (i)	red	ALLOW pink REJECT red-orange	1
(ii)	H ⁺	ALLOW H ₃ O ⁺	1
			Total 11

Question number	Answer	Notes	Marks
8 (a)	M1 (electrostatic) attraction between (two) nuclei M2 and shared/bonding <u>pair</u>(s) of electrons OR M1 (electrostatic) attraction between shared/bonding <u>pair</u>(s) of electrons M2 and (two) nuclei	nuclei must be plural ALLOW nucleus of both/two atoms nuclei must be plural	2
(b)	An explanation that links the following three points M1 diamond is a giant covalent structure/giant lattice structure M2 there are (many) strong covalent bonds (which need to be broken) M3 large amount of (heat/thermal) energy needed to break the covalent bonds	IGNORE giant molecule IGNORE more energy no M2 or M3 if reference to intermolecular forces/ions in diamond	3
(c)	An explanation that links the following two points M1 (graphite has) <u>delocalised</u> electrons M2 (electrons) are mobile/move/flow	Ignore free electrons M2 dep on mention of electrons Ignore carry charge 0 marks if reference to ions in graphite or atoms moving	2
(d)	M1 (number of atoms =) $60 \times 6.0 \times 10^{23}$ M2 3.6×10^{25}	correct answer without working scores 2 answer must be in correct standard form to 1 decimal place	2
			Total 9

Question number	Answer	Notes	Marks
9 (a) (i)	the metal oxide/it loses oxygen	ACCEPT metal ions gain electrons Ignore metal oxide gains electrons	1
(ii)	(the gas would escape and) it is flammable/could cause a fire/could cause an explosion		1
(iii)	An explanation that links the following two points M1 to stop oxygen/air entering the tube OWTTE M2 as some of the metal would change back to the metal oxide/be oxidised/react with oxygen OWTTE		2
(iv)	A description that refers to the following two points M1 reheat the tube and contents(and reweigh when cool) M2 (repeat) until constant mass is obtained OWTTE	ALLOW repeat the instructions/repeat what I did Reheat to constant mass scores 2	2
(b) (i)	M1 mass of oxygen = $4.46 - 4.14$ OR 0.32 (g) M2 (moles of oxygen atoms = $0.32 \div 16 =$) $0.02(0)$	correct answer without working scores 2 ALLOW ecf on incorrect mass of oxygen atoms	2
(ii)	(moles of M =) $0.02(0)$	ALLOW ecf as long as an attempt has been made to find moles	1
(iii)	M1 (A_r of M =) $4.14 \div 0.02(0)$ M2 207	ALLOW ecf from (ii) 207 without working scores 2 ALLOW ecf on incorrect mass of M or incorrect moles -use of 4.46 gives 223 (scores 1)	2
(iv)	Pb/lead	ALLOW ecf on incorrect A_r of M as long as calculation in (ii) and/or (iii) is viable Use of 4.46 gives 223 Francium (scores 1)	1
			Total 12

Question number	Answer	Notes	Marks
10 (a)	to remove excess/unreacted/undissolved/insoluble zinc/solid/metal		1
(b)	A description that refers to the following four points M1 heat the solution to evaporate some of the water/ to form a saturated solution/ to crystallisation point M2 leave the solution to cool /leave the solution for (more) crystals to form M3 filter off the crystals M4 suitable method of drying the crystals	Max 1 mark if solution evaporated to dryness If solution left to partially evaporate without heating only M3 and M4 can be awarded Decant/pour off solution/pick out crystals IGNORE references to washing e.g. dry between filter papers/dry in a warm oven/ leave to dry REJECT hot oven or direct heating with Bunsen burner No M4 if crystals are washed after drying	4
(c) (i)	M1 moles of zinc = $\frac{9.75}{65}$ OR 0.15(0) M2 mass of $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ = $297 \times 0.15(0)$ (g) = 44.55 (g)	44.55 / 44.6 (g) without working scores 2 ALLOW $297 \times 9.75/65$ = 44.55/44.6 for 2 marks $297 \times 9.75 / 30 = 96.52$ scores 0	2
(ii)	M1 $36.4 \div 44.55 \times 100$ M2 81.7(%)	ALLOW ecf from (i) ALLOW any number of sig figs except 1 but rounded correctly correct answer without working scores 2 use of 44.6 gives 81.6(%) / 82 use of 45 gives 80.9(%) / 81	2
			Total 9

