Pearson Edexcel

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)	$H_2O(g) \rightarrow H_2O(l)$	**ACCEPT** multiples Formula must be correct **ALLOW** steam(g) $\rightarrow$ water(l) water(g) $\rightarrow$ water(l) **Water vapour(g)** $\rightarrow$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

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a)</td><td><table><tr><th></th><th>Electron</th><th>Proton</th><th>Neutron</th></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><tr><td>ALLOW</td><td>-</td><td>+</td><td></td></tr></table></td><td>All 4 correct 2 marks
2 or 3 correct 1 mark</td><td>2</td></tr>
<tr><td>(b) (i)

(ii)

(iii)</td><td>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

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

S</td><td>

ALLOW nitrogen/N/N_2</td><td>1

1

1</td></tr>
<tr><td>(c) (i)

(ii)</td><td>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

M1 20.6 × 10 + 79.4 x 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</td><td>

IGNORE same number of electrons

IGNORE references to atomic and mass numbers

ALLOW ecf if incorrect mass numbers used

10.8 without working scores 3

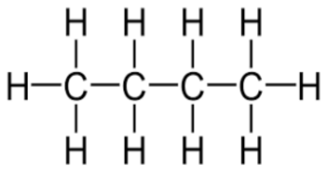
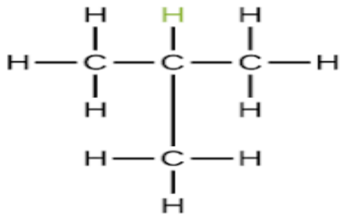
10.79/10.794 without working scores 2

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</td><td>2

3</td></tr>
<tr><td></td><td></td><td></td><td>Total 10</td></tr>
</table>

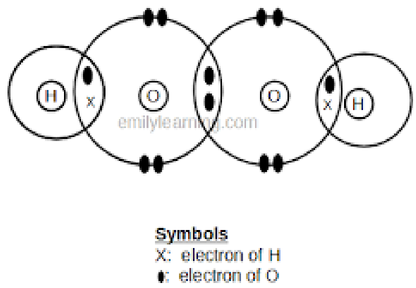
Question number			Answer	Notes	Marks
3	(a)	(i)	fractional distillation	**ALLOW** fractionating	1
		(ii)	(crude oil/it is) heated / vapourised/ boiled	Ignore evaporated	1
		(iii)	E	**ALLOW** gasoline/petrol	1
		(iv)	kerosene	**ALLOW** paraffin	1
		(v)	(Fuel) for ships	**ALLOW** any acceptable use of fuel 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 long**er** chain/molecules ORA **M2** B has strong**er** 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 larg**er/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_2O_3 /silicon dioxide /aluminium oxide /aluminosilicates /zeolites	1
		(ii)	Any one of the following two pairs **M1** C_2H_4 and **M2** C_5H_{10} **OR** **M1** C_3H_6 and **M2** C_4H_8	If the equation does not balance allow 1 mark for a correct formula of an alkene	2
		(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)	$(12 + 2 \times 16 =)$ 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)	$CuCO_3 \rightarrow CuO + CO_2$	**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  **M2** displayed formula of methylpropane 	REJECT molecular formula in structure Accept either order	2
(b) (i)	ultraviolet/UV (radiation)	**ALLOW** ultraviolet/UV light/rays	1
(ii)	$C_2H_6 + Br_2 \rightarrow C_2H_5Br + HBr$	**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

(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. 	**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)	REJECT if reference to less/more kinetic energy/less movement	3
			M2 fewer collisions per unit time/less frequent collisions	IGNORE less chance of collisions REJECT if reference to less/more kinetic energy/less movement	
			M3 (so) rate of reaction decreases	MAX 1 mark can be awarded here If kinetic energy/particle movement mentioned in answer	
		(ii)	**M1** curve starting at 0 and less steep than original curve **M2** curve levelling off at 46-48 cm^3 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)/Fe^{2+} compound **M3** if a brown precipitate forms it is an iron(III)/Fe^{3+} 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 ÷ 56 = 0.05(0) **M2** 2 mol iron reacts with 3 mol chlorine **M3** moles of Fe to react with Cl_2 = $\frac{0.060 \times 2}{3}$ = 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 Cl_2 = $\frac{0.060 \times 2}{3}$ = 0.04(0) **M4** 0.04(0) × 56 = 2.24 g (so iron is in excess) **OR** **M1** moles of iron = 2.8 ÷ 56 = 0.05(0) **M2,M3** moles of Cl_2 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_3O^+	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 ÷ 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 ÷ 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 $Zn(NO_3)_2.6H_2O$ = 297 × 0.15(0) (g) = 44.55 (g)	44.55 / 44.6 (g) without working scores 2 ALLOW 297 X 9.75/65 =44.55/44.6 for 2 marks 297 X 9.75 /30 = 96.52 scores 0	2
(ii)	**M1** 36.4 ÷ 44.55 × 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

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