AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.4

Relative electrical charges of subatomic particles

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**18**
Available paper years	**2018–2025**

Using this booklet

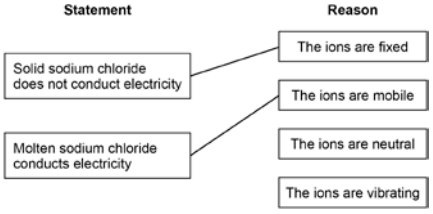
1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.1.1.4 Relative electrical charges of subatomic particles

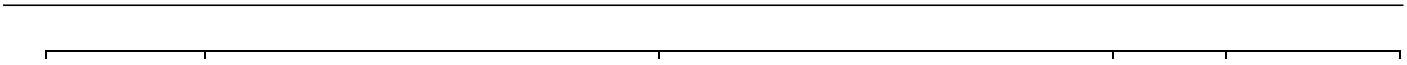
Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	ionic		1	AO1 5.2.1.3
01.2	a molecule		1	AO1 5.2.1.4
01.3	a fullerene		1	AO1 5.2.3.3
01.4	covalent		1	AO1 5.2.3.2
01.5	1		1	AO1 5.2.3.2
01.6	solid		1	AO1 5.2.2.8
01.7	electrons		1	AO1 5.2.2.8
01.8	dissolved		1	AO1 5.2.2.3
01.9		do **not** accept if more than 1 line from 1 box	1 1	AO1 5.2.2.3
Total			**10**	

5.1.1.4 Relative electrical charges of subatomic particles

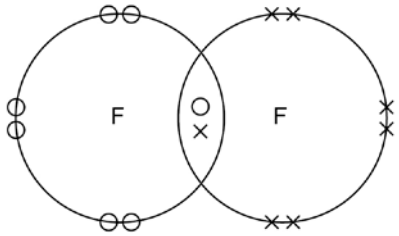
Answer 01 · Mark scheme

June 2018 | 8464/C/1F | Original Q1



5.1.1.4 Relative electrical charges of subatomic particles

Answer 02 · Mark scheme June 2018 | 8464/C/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	group 7		1	AO1 5.1.2.6
02.2		one shared pair anywhere in overlap between two circles **or** on intersection 6 other electrons on each atom allow dots **or** crosses **or** mixture for all marks ignore any inner shell electrons	1 1	AO2 5.1.2.6 5.2.1.4
02.3	bromine potassium chloride	allow correct chemical formulae either order	1 1	AO2 5.1.1.1 5.1.2.6
02.4	displacement		1	AO1 5.1.2.6
02.5	(an) electron		1	AO2 5.1.2.6
02.6	smaller than		1	AO2 5.1.2.1 5.1.2.6

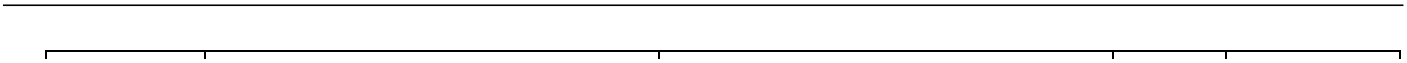
5.1.1.4 Relative electrical charges of subatomic particles

02.7	(chlorine has) fewer levels / shells (of electrons)	mark independent of answer to question **02.6** allow converse for bromine allow (chlorine has) fewer electrons allow Cl has 3 levels / shells and Br has 4 levels / shells ignore atomic number **or** mass number **or** number of protons	1	AO2 5.1.2.1 5.1.2.6
02.8	3	allow multiples	1	AO2 5.1.1.1 5.1.2.6
02.9	there are weak forces between molecules which require little energy to overcome / break	do **not** accept weak bonds allow weak intermolecular forces for the first **2** marks allow does not need much energy to boil	1 1 1	AO1 5.1.2.6 5.2.2.4 AO1 5.1.2.6 5.2.2.4 AO2 5.1.2.6 5.2.2.4
Total			**13**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 02 · Mark scheme

June 2018 | 8464/C/1F | Original Q2



5.1.1.4 Relative electrical charges of subatomic particles

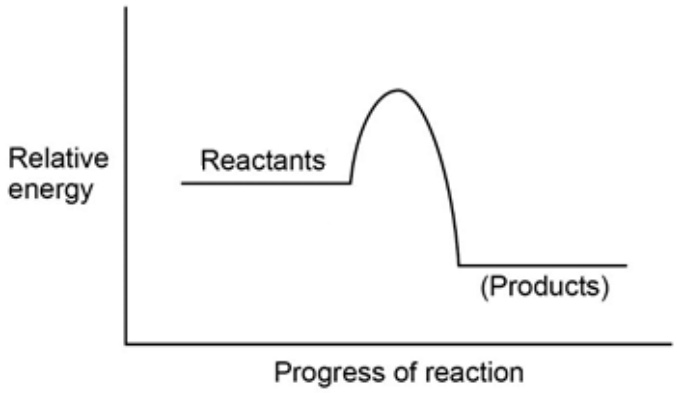
Answer 03 · Mark scheme June 2018 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(difference) sodium has one and chlorine has seven electrons in outer level / shell **or** number of electrons	number of electrons must be correct if quoted	1	AO2 5.1.1.7 5.1.2.1
	(similarity) both have three / same number of levels / shells **or** have electrons in third level / shell **or** both have incomplete (outer) levels / shells	allow both have 2 electrons in inner shell **or** both have 8 electrons in second shell **or** both are one electron away from full outer level / shell	1	
06.2		allow marks from suitable diagram(s)		AO1 5.2.1.2
	sodium (atom) loses	allow moves / transfers for loses do **not** accept sodium ion loses	1	
	one (outer shell electron)		1	
	chlorine (atom) gains	do **not** accept chloride	1	
	one (electron)		1	
		transfer of 1 electron from chlorine to sodium **max 2** marks		
		reference to sharing **or** covalent bonding **max 3** marks		

5.1.1.4 Relative electrical charges of subatomic particles

Answer 03 · Mark scheme

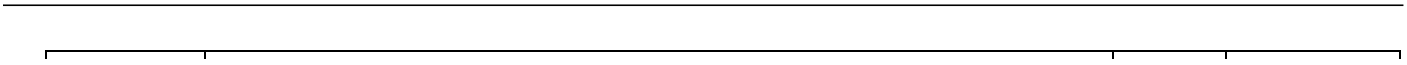
June 2018 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		ignore labels any curve / line going up and then down products line below reactants allow curve to start / finish anywhere along reactant / product lines	1 1	AO1 5.5.1.2
Total			**8**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 03 · Mark scheme

June 2018 | 8464/C/1F | Original Q6



5.1.1.4 Relative electrical charges of subatomic particles

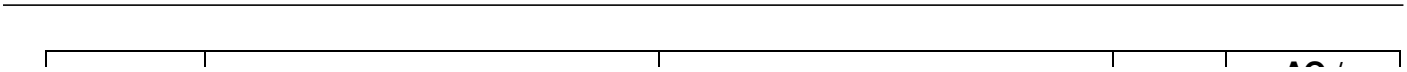
Answer 04 · Mark scheme June 2018 | 8464/C/2F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	16		1	AO2 5.1.1.5
01.2	8 e^- in 2nd shell 6 e^- in 3rd shell	allow ●, x ,e^- or any combination	1	AO2 5.1.1.7
01.3	oxygen → sulfur dioxide	allow = in place of → do **not** accept sulfur oxide ignore symbols	1	AO2 5.1.1.1 5.9.3.1
01.4	acid rain		1	AO1 5.9.3.2
01.5	yes / no any **two** from: • increases • constant • decreases correct date range for any one of the above • (increases) 1984–1987 • (constant) 1987–1990 • (decreases) 1990–2014	 allow goes up allow similar allow goes down allow levels off (at the end)	 2 1	 AO3 5.9.3.1 AO2 5.9.3.1
01.6	(69 + 6 =) 75 100 – 75 = 25(%)	an answer of 25(%) scores **2** marks allow a final percentage calculated from an incorrect value in the first step	 1 1	AO2 5.9.3.1
Total			**9**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 04 · Mark scheme

June 2018 | 8464/C/2F | Original Q1



5.1.1.4 Relative electrical charges of subatomic particles

Answer 05 · Mark scheme June 2019 | 8464/C/1F | Original Q3

03.1	atomic weight of element		1	AO1 5.1.2.2
03.2	gaps	allow spaces / blanks do **not** accept undiscovered elements	1	AO1 5.1.2.2
03.3	noble gases		1	AO1 5.1.2.4
03.4	18 22	this order only	1 1	AO2 5.1.1.5
03.5	isotopes		1	AO1 5.1.1.5
03.6	2,8,8		1	AO2 5.1.1.5
03.7	stable arrangement (of electrons)	allow full outer shell allow eight electrons in the outer shell allow does not need to gain or lose electrons	1	AO1 5.1.2.4
Total			**8**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 05 · Mark scheme

June 2019 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 06 · Mark scheme June 2019 | 8464/C/1F | Original Q4

04.1	2 Na + Cl_2 → 2 NaCl	allow multiples	1	AO1 5.1.2.2
04.2	7.1 (g)		1	AO2 5.3.1.1
04.3	silver green yellow white	this order only allow yellow allow white	1 1 1 1	AO1 5.1.2.5
04.4	Na^+ Cl^-	if no other mark awarded allow **1** mark for +(1) charge for sodium ion and –(1) charge for chloride ion	1 1	AO1 5.2.1.2
04.5	an electron		1	AO2 5.1.2.5

5.1.1.4 Relative electrical charges of subatomic particles

Answer 06 · Mark scheme

June 2019 | 8464/C/1F | Original Q4

04.6	potassium (atom) is larger potassium (atom) has more energy levels (of electrons) **or** potassium (atom) has more shells (of electrons)	allow converse for sodium mark independently do **not** accept more outer shells	 1 1	AO2 5.1.2.1 & 5.1.2.5

Total			**11**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 06 · Mark scheme

June 2019 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

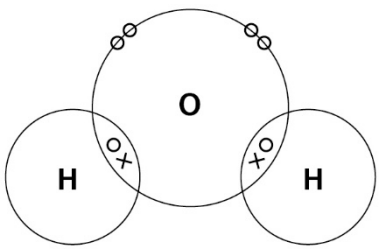
5.1.1.4 Relative electrical charges of subatomic particles

Answer 07 · Mark scheme June 2019 | 8464/C/1F | Original Q5

05.1	(g)	allow g ignore formulae	1	AO1 5.2.2.2

05.2	40 (%)		1	AO2 5.1.1.1

05.3		an answer of 3.94 (g) scores **3** marks		AO2 5.3.1.3
	$\frac{3.76 + 3.98 + 4.09}{3}$ **or** $\frac{11.83}{3}$		1	
	= 3.943(333333333333333)		1	
	= 3.94 (g)	allow a correctly written answer to 3 significant figures from an incorrectly calculated mean	1	

05.4		allow combination of circles, dots, crosses or $e^{(-)}$		AO1 5.2.1.4
	one shared pair in each overlap	do **not** accept extra electron(s) on outer shell of hydrogen	1	
	4 non-bonding electrons in outer shell of oxygen		1	
		ignore any inner shell electrons		
		 diagram scores 2 marks		

5.1.1.4 Relative electrical charges of subatomic particles

Answer 07 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

05.5	covalent		1	AO1 5.2.2.1 5.2.2.4

05.6	higher (than) stronger (than between oxygen molecules)		1 1	AO2 5.2.2.4

Total			**10**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 07 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 08 · Mark scheme November 2020 | 8464/C/1F | Original Q5

05.1	atomic weight		1	AO1 5.1.2.2
05.2	(because) properties were similar **or** (because) iodine has similar / same properties as bromine / chlorine / fluorine	allow symbols	1	AO3 5.1.2.2
05.3	solid		1	AO3 5.1.2.5 5.2.2.1
05.4	scale on the y-axis up to 180 bar for sodium at 98 (°C) bar for potassium at 63 (°C)	ignore scale beyond 180 allow a tolerance of ± half a small square allow a tolerance of ± half a small square	1 1 1	AO2 5.1.2.4 5.2.2.1
05.5	 lithium (atom) loses one electron chlorine (atom) gains one electron any **one** from: • ions are formed • lithium forms positive ion • chlorine forms negative ion • form a full outer shell(s) / level(s)	max **2** marks if reference to incorrect particle / bonding allow ionic bonding allow noble gas structure is formed	 1 1 1	 AO2 AO2 AO1 5.1.2.3 5.2.1.2

5.1.1.4 Relative electrical charges of subatomic particles

05.6	any **two** from: • reactivity of elements increases going down the group • potassium has more shells • potassium can lose an (outer) electron more easily • potassium has an outer shell / electron further away from the nucleus • potassium has more shielding (of the outer shell / electron) • potassium has a weaker attraction between nucleus and outer shell / electron	allow energy levels for shells allow converse for lithium	2	AO1 AO2 5.1.2.3 5.1.2.5

Total			**11**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 08 · Mark scheme

November 2020 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 09 · Mark scheme November 2020 | 8464/C/1F | Original Q6

06.1	13 14	this order only	1 1	AO2 5.1.1.4 5.1.1.5
06.2	loss of oxygen	allow (Al^{3+}) gain of electrons allow aluminium oxide loses oxygen	1	AO1 5.4.1.1 5.4.1.3
06.3	 (at high temperature) oxygen reacts with carbon / electrode (so the positive) electrode burns / wears away to produce carbon dioxide	allow anode for (positive) electrode $C + O_2 \rightarrow CO_2$ scores MP1 and MP3	 1 1 1	 AO1 5.4.3.1 5.4.3.2 5.4.3.3
06.4	(delocalised) electron(s) ion(s) (delocalised) electron(s)		1 1 1	AO1 AO2 AO1 5.2.2.3 5.2.2.8 5.2.3.2
Total			**9**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 09 · Mark scheme

November 2020 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.

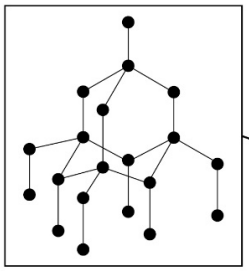
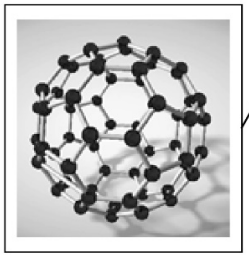
5.1.1.4 Relative electrical charges of subatomic particles

Answer 10 · Mark scheme November 2021 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	0.1 nm		1	AO1 5.1.1.5
03.2	6 protons		1	AO2
	8 neutrons		1	AO2
	6 electrons	allow electron (structure) 2,4	1	AO2
	protons in nucleus		1	AO1
	neutrons in nucleus		1	AO1
	electrons (around nucleus) in energy levels / shells		1	AO1 5.1.1.4 5.1.1.5 5.1.1.7
03.3	3		1	AO1 5.2.2.6 5.2.3.2
03.4	covalent		1	AO1 5.2.2.6 5.2.3.2
03.5	layers slide (over each other)	allow atoms slide over each other	1	AO3 5.2.3.2

5.1.1.4 Relative electrical charges of subatomic particles

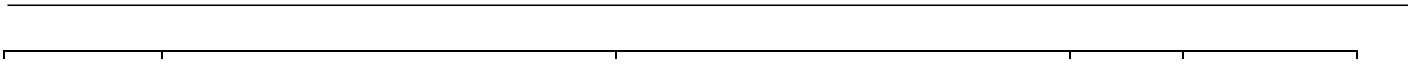
Answer 10 · Mark scheme

03.6	**Structure**   **Form of carbon** Buckminsterfullerene — Diamond — Graphene — Nanotube do **not** accept more than **one** line from a box on the left	1 1	AO1 5.2.3.1 5.2.3.3
Total		**12**	

5.1.1.4 Relative electrical charges of subatomic particles

Answer 10 · Mark scheme

November 2021 | 8464/C/1F | Original Q3



5.1.1.4 Relative electrical charges of subatomic particles

Answer 11 · Mark scheme

June 2022 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	alkali metals		1	AO1 5.1.2.5

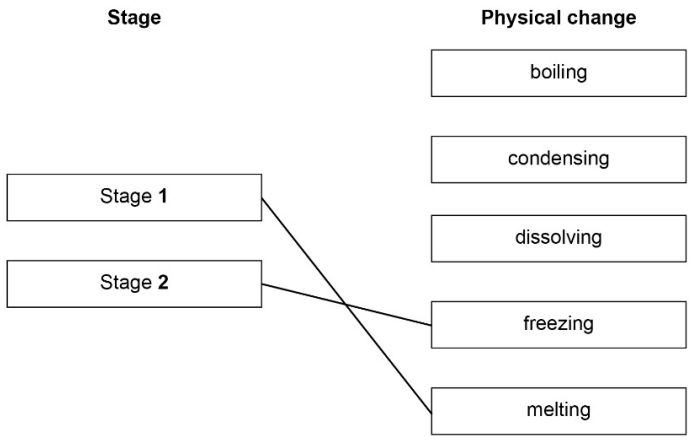
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	3 / three 4 / four	must be in this order	1 1	AO2 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	+1		1	AO2 5.1.1.4

5.1.1.4 Relative electrical charges of subatomic particles

Answer 11 · Mark scheme

June 2022 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	 do **not** accept more than one line from a box on the left		1 1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	28 (°C)		1	AO2 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	bar plotted at 63 °C	allow a tolerance of ± ½ a small square	1	AO3 5.1.2.5

5.1.1.4 Relative electrical charges of subatomic particles

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	(melting point) decreases as go down Group 1	allow converse in terms of increasing melting point ignore boiling points allow **1** mark for (melting point) decreases	2	AO1
	(and the) differences get smaller **or** initial drop is largest		1	AO3 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	liquid		1	AO3 5.1.2.5 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.9	loses an electron		1	AO1 5.1.1.7 5.1.2.1 5.1.2.5

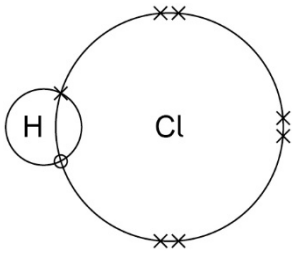
Total Question 1		**13**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 12 · Mark scheme

June 2022 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	one shared pair in overlap	allow any combination of circles, dots, crosses or $e^{(-)}$	1	AO1 5.1.2.6 5.2.1.4
	6 non-bonding electrons in outer shell of chlorine	do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	sodium chloride	allow NaCl	1	AO2 5.4.2.2

5.1.1.4 Relative electrical charges of subatomic particles

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	5.85 (g)		1	AO2 5.3.1.1 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	17.6 (°C)		1	AO2 5.4.2.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	exothermic (reaction)	allow neutralisation (reaction)	1	AO2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	Na^+ OH^-		1 1	AO1 AO2 5.4.2.2 5.4.2.4 5.5.1.1

Total Question 2		**8**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 13 · Mark scheme

June 2023 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(number of protons) 4 (number of neutrons) 5		1 1	AO2 5.1.1.4 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	+2		1	AO2 5.1.1.7 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	gas		1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	freezing		1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	heat	allow evaporate / boil	1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6			1	AO1 5.1.1.3

5.1.1.4 Relative electrical charges of subatomic particles

Answer 13 · Mark scheme

June 2023 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	chadwick		1	AO1 5.1.1.3

Total Question 1	**8**

5.1.1.4 Relative electrical charges of subatomic particles

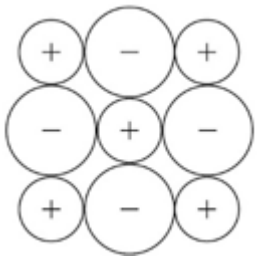
Answer 14 · Mark scheme

June 2023 | 8464/C/1F | Original Q3

Question 3

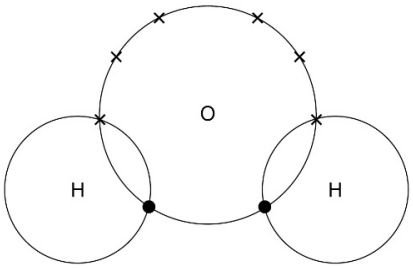
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	noble gases		1	AO1 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	potassium (atoms) lose electrons		1	AO2
	chlorine (atoms) gain electrons		1	AO2
	reference to one electron		1	AO2
	any **one** from: • to form ions • to form full outer shell(s) • to form full energy level(s)	allow to form a noble gas structure	1	AO1 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3			1	AO2 5.2.1.3

5.1.1.4 Relative electrical charges of subatomic particles

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	one shared pair in each overlap	allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons	1	AO1 5.2.1.1 5.2.1.4
	four non-bonding electrons in outer shell of oxygen	do **not** accept extra electron(s) on outer shell of hydrogen ignore any inner shell electrons the diagram below scores 2 marks 	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	1 Si : 2 O	allow 6 Si : 12 O	1	AO3 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	weak intermolecular forces		1	AO1 5.2.2.5

5.1.1.4 Relative electrical charges of subatomic particles

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7		ignore references to boiling point		AO3 5.2.2.4 5.2.2.5
	the melting point increases as the length of the polymer molecule increases	allow **1** mark for melting point increases	2	
	(then the) melting point levels off (as the polymer molecule length increases)	allow (then the) melting point becomes constant (as the polymer molecule length increases)	1	

Total Question 3	**13**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 15 · Mark scheme

June 2024 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	alkali metals		1	AO1 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	0.2 nm		1	AO1 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	atomic number		1	AO1 5.1.1.5

Question	Answers	Mark	AO / Spec. Ref.
01.4	<table><tr><th>Name</th><th>Relative charge</th></tr><tr><td>Proton</td><td>**+(1)**</td></tr><tr><td>**Neutron**</td><td>0</td></tr><tr><td>Electron</td><td>-1</td></tr></table>	1 1	AO1 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	+1		1	AO2 5.1.1.7 5.1.2.3 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	63 (°C)	allow a value in the range 50–80 (°C)	1	AO3 5.1.2.5

5.1.1.4 Relative electrical charges of subatomic particles

Answer 15 · Mark scheme

June 2024 | 8464/C/1F | Original Q1

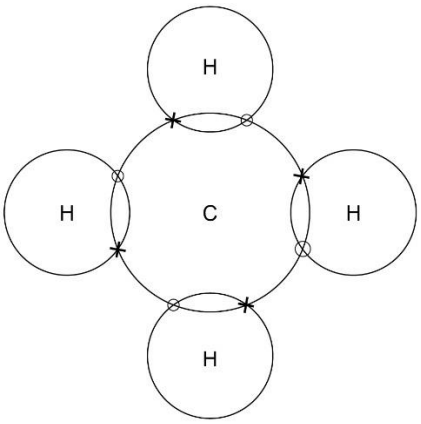
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	$A_r = \frac{(39 \times 93) + (41 \times 7)}{100}$		1	AO2 5.1.1.6

Total Question 1	**8**

5.1.1.4 Relative electrical charges of subatomic particles

Answer 16 · Mark scheme June 2024 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	one pair of electrons drawn in each of the three overlaps	allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons ignore inner shell electrons on the carbon atom do **not** accept extra electron(s) on outer shell of carbon / hydrogen allow **1** mark for one shared pair in one overlap without non-bonding electron(s) on that hydrogen an answer of  scores **2** marks	2	AO1 5.2.1.1 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2			1	AO1 5.2.1.4 5.2.2.6 5.2.3.1

5.1.1.4 Relative electrical charges of subatomic particles

Answer 16 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	3		1	AO1 5.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(delocalised) electrons	allow (free) electrons	1	AO2 5.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	in electronic components		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	any **two** from: • hollow (shape) • hexagonal rings • (of) carbon atoms • each (carbon) atom forms 3 (covalent) bonds	 allow cylindrical (shape) allow (nano)tube allow (made of) hexagons	2	AO1 5.2.3.3

Total Question 2	8

5.1.1.4 Relative electrical charges of subatomic particles

Answer 17 · Mark scheme June 2025 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	electron		1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	nucleus		1	AO1 5.1.1.3

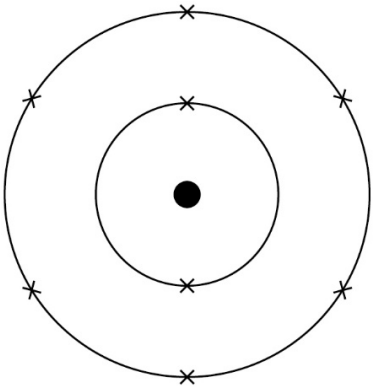
Question	Answers	Mark	AO / Spec. Ref.
01.3	**Subatomic particle** / **Relative charge of the particle** Electron → +1 Neutron → 0 Proton → –1 allow **1** mark for 1 or 2 correct do **not** accept more than one line from a box on the left	2	AO1 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the number of protons only		1	AO1 5.1.1.4

5.1.1.4 Relative electrical charges of subatomic particles

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$(A_r =) \frac{(10 \times 19.7) + (11 \times 80.3)}{100}$	allow $(A_r =) \frac{197 + 883.3}{100}$ allow $(A_r =) \frac{1080.3}{100}$	1	AO2 5.1.1.6
	= 10.803		1	
	= 10.8		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6		allow any combination of x, O, $e^{(-)}$, ● for electrons	1	AO2 5.1.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	model **B** shows the 3D arrangement of the ions		1	AO3 5.2.1.3
	model **B** shows the relative sizes of the ions		1	

Total Question 1	**11**

5.1.1.4 Relative electrical charges of subatomic particles

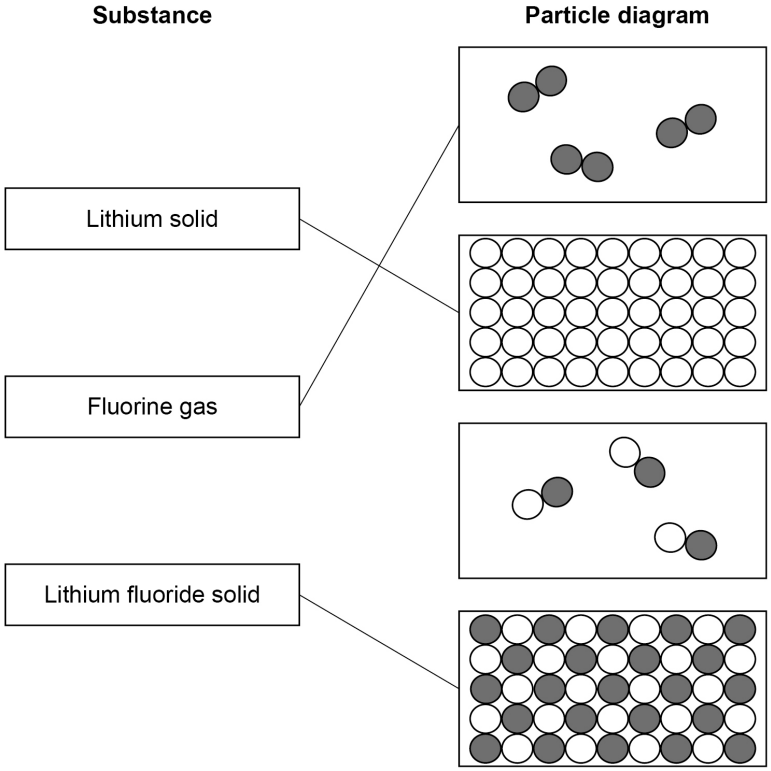
Answer 18 · Mark scheme

June 2025 | 8464/C/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	Li		1	AO1 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	delocalised electrons from the outer shell		1	AO1 5.2.1.5

Question	Answers	Mark	AO / Spec. Ref.
02.3	 do **not** accept more than one line from a box on the left	1 1 1	AO3 5.1.1.1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	**D**		1	AO3 5.2.2.3

5.1.1.4 Relative electrical charges of subatomic particles

Answer 18 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	diamond		1	AO1 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(relative formula mass =) 12 + (19 × 4) = 88		1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	6	allow 3 pairs	1	AO2 5.2.1.1 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	nitride		1	AO2 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	neon has a stable arrangement of electrons		1	AO1 5.1.2.4

Total Question 2	12

5.1.1.4 Relative electrical charges of subatomic particles

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q1

Question 1 (low demand)

01.1 47% of students correctly identified that the diagram for calcium oxide showed ionic bonding.

01.2 41% of students recognised that the bonding diagram for methane showed a molecule of methane.

01.3 The diagram of a fullerene was not recognised by 71% of students.

01.4 44% of students correctly identified, from the diagram, that the type of bond in graphite is covalent.

01.5 This question proved to be difficult because it required students to understand that in one covalent bond there is a shared pair of electrons, so one electron comes from each atom. 11% of students gave a correct answer.

01.6 This question was accessible to most students (76%) because the answer should have been obvious from the diagram that showed a solid between the electrodes.

01.7 66% of students knew that copper conducts electricity by the movement of delocalised electrons.

01.8 49% of students could use the labelled diagram to understand that the sodium chloride was dissolved to form the sodium chloride solution.

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q1

01.9 19% of students knew that solid sodium chloride does not conduct electricity because the ions are fixed, whereas molten sodium chloride conducts electricity because the ions are mobile. Some students did not follow the instructions and drew more than one line from each statement box. 56% of students were awarded at least one mark.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 02 · Examiner comments

June 2018 | 8464/C/1F | Original Q2

Question 2 (low & standard demand)

02.4 47% of students knew that the type of reaction between chlorine and potassium bromide solution is called displacement.

02.5 73% of students knew that chlorine is more reactive than bromine because chlorine gains electrons more easily.

02.6 60% of students understood that a chlorine atom is smaller than a bromine atom.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 03 · Examiner comments

June 2018 | 8464/C/1F | Original Q6

Question 6 (standard demand)

06.1 This question discriminated well with 27% of students achieving some degree of credit. Many students did not consider the most obvious difference and similarity in the electronic structures of sodium and chlorine. Students often used the periodic table shown in the stem of the question to answer this question, but most of these students referred to periods or rows and groups or columns and so failed to gain any marks.

06.2 This question discriminated well. 23% of students achieved all four marks, often with concise statements about the transfer of the outer electron of sodium to chlorine.

Some students contradicted their description by mentioning covalent bonding, or the sharing of electrons, which restricted the number of marks they could attain. Poor expression and the use of incorrect terms were the main problem for most students. It was common to see the term ‘atom’ used instead of ‘electron’. 19% of students did not attempt to answer this question.

06.3 This question discriminated well. 26% of students achieved both marks; whereas 185 of students achieved a single mark. It was common for students to have incomplete reaction profile diagrams, by failing to include a horizontal line for the products.

Some students confused the two types of energy changes (endothermic and exothermic), while others provided a wide range of incorrect diagrams. Labels were ignored because they were not required to answer the question. 20% of students did not attempt to answer this question.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 10 · Examiner comments

November 2021 | 8464/C/1F | Original Q3

Question 3 (low demand)

03.1 Nearly two thirds of students were able to give the approximate radius of a carbon atom.

03.2 Students were good at describing the atomic structure of the carbon atom. More than half of students scored at least three marks. A few did not use the given diagram of the carbon atom to determine the number of neutrons located in this atom's nucleus.

03.3 Nearly half of students were able to use the diagram of graphite's structure to determine the number of covalent bonds each carbon atom has in graphite. Four proved to be a popular incorrect response, which is the number of covalent bonds each carbon atom forms in substances such as diamond or methane.

03.4 Nearly two thirds of students knew that covalent bonds hold carbon atoms together in graphite.

03.5 Few students stated that layers (of carbon atoms) can slide over each other in graphite or were able to use the diagram of graphite's structure to explain why graphite can be used as a lubricant.

03.6 Nearly two thirds of students gained one mark and approximately one sixth of students gained two marks for linking the structures with the correct form of carbon.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 11 · Examiner comments June 2022 | 8464/C/1F | Original Q1

Question 1 (Low demand)

01.1 Almost three-quarters of the students could correctly identify Group 1 metals as the alkali metals.

01.2 Just over 60% of students correctly deduced the number of electrons and the number of neutrons from the structure of a lithium atom.

01.3 The relative charge on a lithium atom was given by more than 55% of the students.

01.4 The physical changes occurring when a solid changes into a liquid and when the liquid changes back into a solid were known by 60% of the students.

01.5 More than 80% of the students were able to read the melting point of caesium from a bar chart.

01.6 More than 80% of the students were able to draw a bar at 63 °C for the melting point of potassium on a bar chart. The most common mistake was for students to misinterpret the scale on the graph. Others did not use a ruler so did not draw a straight horizontal line.

01.7 Almost half of the students gained two marks, for describing the trend as the melting point decreases going down Group 1. Many students recognised that the melting points decrease but had difficulty in articulating that this is as you go down or descend the group. Very few accessed the third marking point which was that the differences got smaller going down the group or that the initial drop was greatest.

01.8 Just under half of the students deduced that sodium is a liquid at 150 °C. Solid proved to be a popular distractor.

01.9 More than a third of students knew that potassium is more reactive than sodium because potassium more easily loses an electron.

Answer 12 · Examiner comments June 2022 | 8464/C/1F | Original Q2

Question 2 (Low demand)

02.1 More than a third of students correctly drew a dot and cross diagram for hydrogen chloride. The most commonly awarded mark was for the two shared electrons in the overlap between the atoms. Many failed to show that there are six unshared electrons.

02.2 Only 20% of students gained this mark for correctly identifying sodium chloride as one of the products of the reaction between hydrochloric acid and sodium hydroxide. The most common error was identifying the product as sodium chlorine. Some students also attempted to add other products to the equation.

02.3 Only 20% of students gained the mark for calculating the correct mass. Many students added the three masses together rather than recognising that in a reaction the mass of reactants equals the mass of products.

02.4 More than three-quarters of the students correctly read the temperature reading on the thermometer scale.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 12 · Examiner comments June 2022 | 8464/C/1F | Original Q2

02.5 Just under a quarter of students knew that when the temperature of a reaction increases an exothermic reaction is taking place. The most common error described the reaction as endothermic.

02.6 30% of students correctly identified that Na^+ and OH^- ions are present in sodium hydroxide.

Answer 13 · Examiner comments June 2023 | 8464/C/1F | Original Q1

Question 1 (low demand)

01.1 Three-quarters of the students correctly deduced the number of protons and the number of neutrons in the beryllium atom. Some students gave the numbers the opposite way around.

01.2 The relative charge on a beryllium ion was given by just over 50% of the students. A charge of 1+ proved to be a good distractor.

01.3 More than 95% of the students were able to identify the arrangement of atoms as a representation of the gas state.

01.4 More than 80% of the students were able to identify the states from the diagram and to link them to freezing, as the process when a liquid changes into a solid.

01.5 About two-thirds of the students were able to identify the states and knew that heating was required to change the states. Condensing was a very common incorrect response which is the reverse process of the direction being asked about.

01.6 Just over three-quarters of students knew the correct order for the development of the model of the atom was tiny sphere, plum pudding and then nuclear model. The most common incorrect distractor also started with the tiny sphere model.

Answer 13 · Examiner comments June 2023 | 8464/C/1F | Original Q1

01.7 Just under half of the students knew that the existence of neutrons was discovered by Chadwick. Mendeleev was the most common incorrect answer.

5.1.1.4 Relative electrical charges of subatomic particles

Answer 14 · Examiner comments June 2023 | 8464/C/1F | Original Q3

Question 3 (low/standard demand)

03.1 More than half the students identified the noble gases as the group of elements that do not form ions.

03.2 This question was a good discriminator. Many gained the first three marks although MP4 was less common. Many incorrect terms such as ‘atoms sharing electrons to form ionic bonds’, ‘metal ions losing electrons’ and ‘non-metal ions gaining electrons’ were seen.

03.3 More than two thirds of students identified the structure that represents the arrangement of ions in solid potassium chloride. The first option was the best distractor.

03.4 More than a quarter of students correctly drew a dot and cross diagram for water. When only one mark was gained this was usually for the shared electrons in the overlap between oxygen and one of the hydrogen atoms. Some failed to show that there are four unshared electrons on the oxygen atom and others added more electrons into the circle around one or both of the hydrogen atoms.

03.5 More than three-quarters of students deduced the ratio of silicon atoms to oxygen atoms from the structure of silica.

Answer 14 · Examiner comments June 2023 | 8464/C/1F | Original Q3

03.6 Only 20% of students knew that weak intermolecular forces hold polymer molecules together in a polymer. Covalent bonds and electrostatic attraction between ions were perhaps terms more familiar to the students and both proved more popular options than the correct answer.

03.7 Students found difficulty in recognising the link between the two variables from the *x*-axis and the *y*-axis. Many stated that as the melting point increases the length of the polymer molecule increases. Students should appreciate that the independent variable is on the *x*-axis and that as this is changed, the effect on the dependent variable (*y*-axis) can be observed ie as the length of the polymer molecule increases (independent, *x*-axis) then the melting point increases (dependent, *y*-axis).

Answer 15 · Examiner comments

June 2024 | 8464/C/1F | Original Q1

Question 1 (low & standard demand)

01.1 Three-quarters of students could name Group 1 elements as the alkali metals. Halogens was the most common incorrect response.

01.2 Three-quarters of students could estimate the radius of a potassium atom as 0.2 nm. A fifth of students selected 0.2 mm.

01.3 The majority of students knew that the atomic number is the number of protons in an atom. Mass number was the most popular incorrect distractor.

01.4 Two-thirds of students gained both marks. Some students failed to indicate that protons are positively charged: + or +1 was needed for the answer. Phonetic spellings of neutron were credited.

0 1 . 4 **Table 1** shows the name and the relative charge of the particles in a potassium atom.

Table 1

Name of particle	Relative charge
Proton	1
Nefron	0
Electron	−1

Complete **Table 1**.

[2 marks]

This response demonstrates a common error in not giving the charge on the proton, but the spelling for neutron is acceptable phonetically so marking point 2 was awarded.

01.5 Students were given the electronic structure of a potassium atom (2,8,8,1) and a diagram showing that a potassium ion has a full outer shell (2,8,8). Nearly two-thirds of students were able to deduce that the ion is formed by losing an electron, which results in the formation of a +1 ion. A quarter of students thought that the ion had a –1 charge.

01.6 Most students were able to correctly predict the melting point of potassium from the trend shown in the bar graph.

01.7 Nearly two-thirds of students knew that relative atomic mass is calculated by multiplying the percentage abundance of each isotope by its mass number and averaging these values for all isotopes. A fifth of students selected the third option.

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Answer 16 · Examiner comments

June 2024 | 8464/C/1F | Original Q2

Question 2 (low & standard demand)

02.1 To help students complete the dot and cross diagram for a methane molecule one shared pair of electrons was drawn in one of the overlap areas. More than half the students correctly added three more shared pairs of electrons. Some gained only 1 mark by either adding just one shared pair or including extra electrons in the outer shells of either the carbon atom or hydrogen atoms.

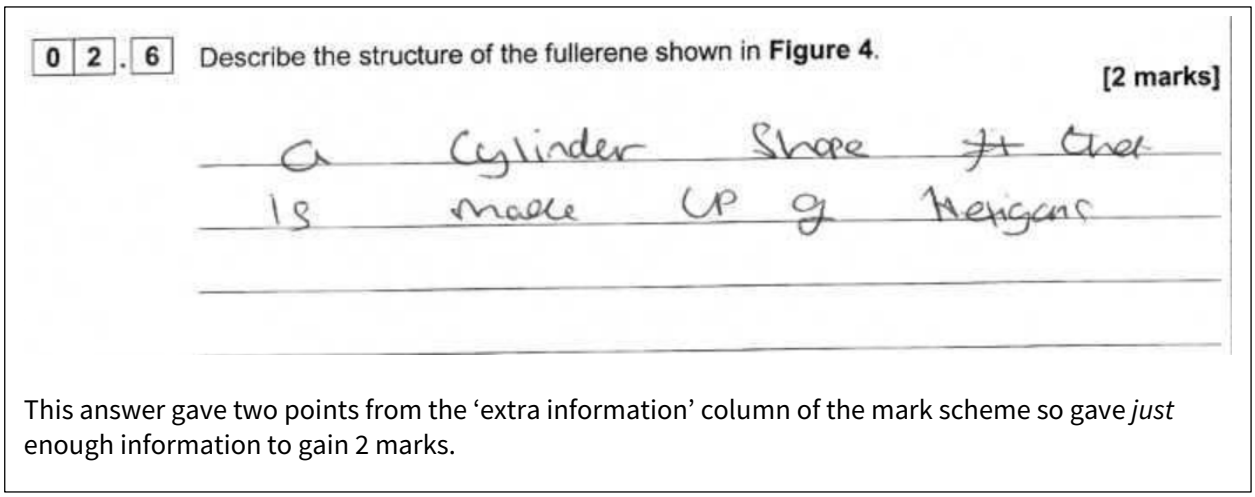
02.2 Three-quarters of students recognised the structure of diamond. Buckminsterfullerene was the most common incorrect response.

02.3 A diagram to represent part of the structure of graphite was given to show that each carbon atom forms three covalent bonds. Nearly 60% of students answered the question correctly. Approximately equal numbers of students thought that carbon atoms formed either two or four bonds with only a small number choosing one bond.

02.4 Just over 40% of the students knew that (delocalised) electrons carry electrical charge through graphite. Many students incorrectly answered that ions or atoms were the particles responsible or wrote carbon for their answer.

02.5 Half of the students knew that fullerenes are used in electronic components. The other two distractors were equally popular.

02.6 Nearly half of the students scored at least 1 mark. A diagram was included to help students describe the structure of a fullerene. The better responses stated that fullerenes are hollow and have hexagonal rings of carbon atoms, although few stated that each carbon atom forms three covalent bonds.



This answer gave two points from the 'extra information' column of the mark scheme so gave *just* enough information to gain 2 marks.

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Answer 17 · Examiner comments

June 2025 | 8464/C/1F | Original Q1

Question 1 (Low and Standard demand)

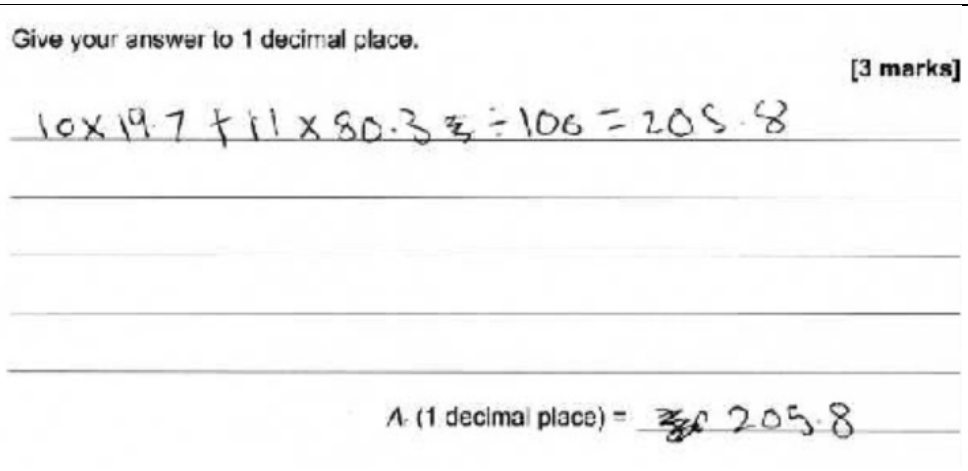
01.1 Just under half of students could name the electron as the first subatomic particle to be discovered. Proton was the most common incorrect response.

01.2 The majority of students knew that the name of the centre of an atom is the nucleus. Phonetic spellings were credited. Common incorrect answers were proton and neutron.

01.3 The majority of students correctly linked the relative charges with each subatomic particle. Many gained 1 mark for showing that the neutron has no charge.

01.4 Less than half of students knew that the atomic number is the number of protons in an atom. The number of number of neutrons + the number of protons in an atom was a more popular incorrect distractor.

01.5 The calculation of the relative atomic mass using the mass numbers and percentage abundance was correctly carried out by nearly two-third of students. The first mark was for the mathematical expression although some students did not divide 1080.3 by 100 and others used their calculator incorrectly. A small number of students who evaluated the expressions as 10.803 did not round their answer to 1 decimal place.



This student did not gain any credit. They only divided the last number (80.3) by 100 so their calculation evaluates as:
10 × 19.7 = 197 then added [11 × (80.3÷100) = 8.833] so 197 + 8.833 = 205.8

01.6 Many students correctly arranged the 8 electrons on the two levels on the figure as 2,8. A number arranged the 8 electrons as 4,4 or 0,8 and others used a different numbers of electrons.

01.7 Less than 20% of students gained 2 marks for Model B shows the 3D arrangement of the ions and the relative sizes of the ions. The most popular incorrect distractors were the charges on the ions and the electronic structures of the ions.

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5.1.1.4 Relative electrical charges of subatomic particles

Answer 18 · Examiner comments

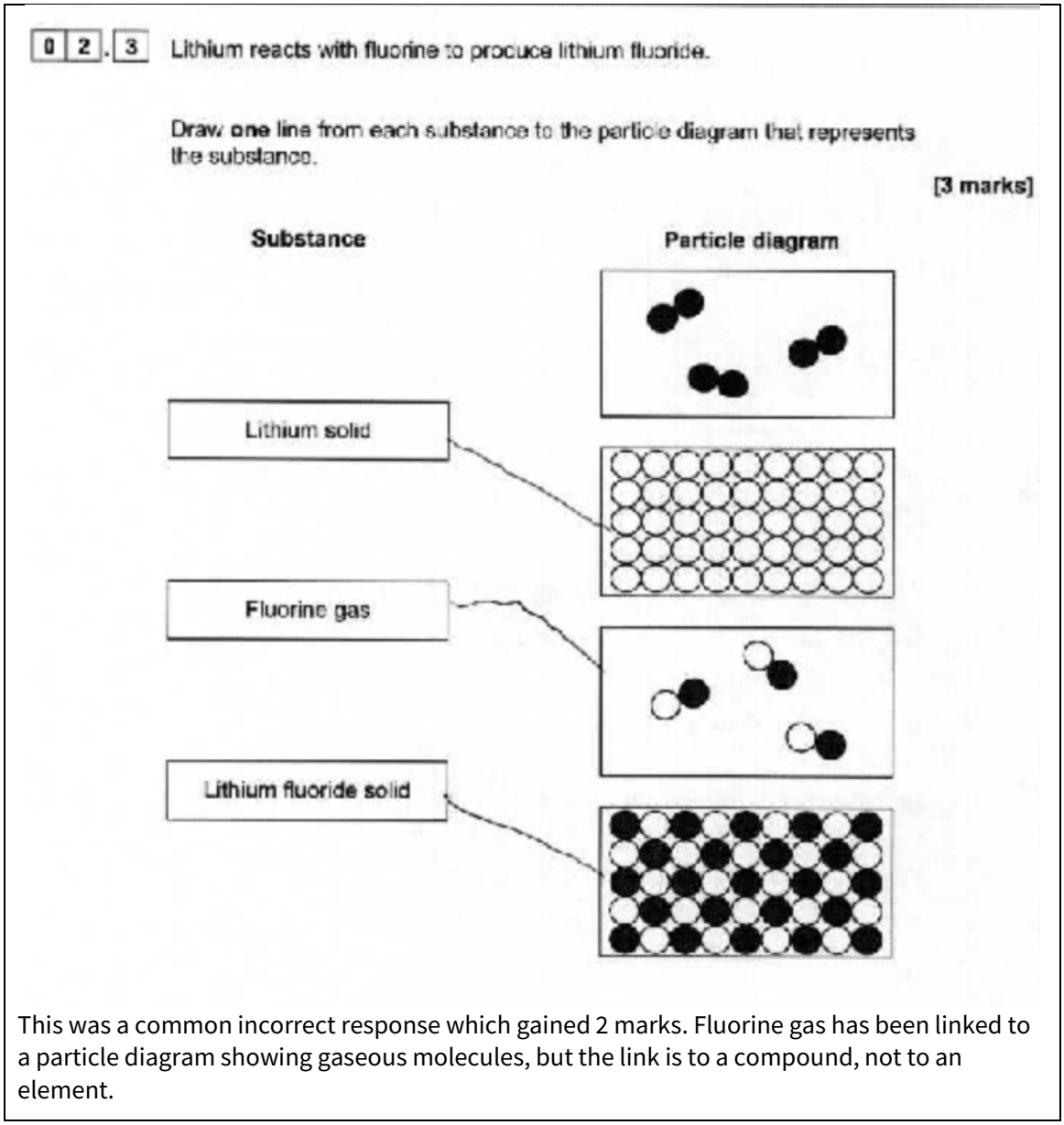
June 2025 | 8464/C/1F | Original Q2

Question 2 (Low demand)

02.1 Many students correctly wrote the chemical symbol of lithium with a capital L followed by a lower case i. When writing symbols lowercase letters must be discernibly smaller than capitals.

02.2 More than half of students knew that delocalised electrons from the outer shell are involved in metallic bonding. Fixed electrons in the outer shell was the most popular incorrect distractor.

02.3 Students should recognise particle diagrams for solid and gaseous states and for elements and compounds. Different colour circles are used to represent different atoms or ions so students should deduce that both the (diatomic) fluorine gaseous molecule and lithium solid particle diagram would only have one colour circle whereas the ionic compound lithium fluoride solid particle diagram would have two different colour circles. The majority of students correctly linked the substance to the particle diagram that represents the substance.



This was a common incorrect response which gained 2 marks. Fluorine gas has been linked to a particle diagram showing gaseous molecules, but the link is to a compound, not to an element.

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5.1.1.4 Relative electrical charges of subatomic particles

Answer 18 · Examiner comments June 2025 | 8464/C/1F | Original Q2

02.4 Just over half the students were able to use the electrical conductivity of a substance when solid and liquid to identify the ionic compound lithium fluoride.

02.5 Just over half the students recognised the structure of diamond. Graphite was the most common incorrect response.

02.6 A third of students gained both marks for 88 with or without working. Some gained 1 mark for the correct mathematical expression or writing 12 + 76. Many students did not multiply the number of atoms by the relative atomic mass of the atom so gave either 31 or 288 by adding or multiplying the A_r values of carbon and fluorine or used the 4 (atoms of fluorine) as a power giving a M_r of several thousand.

02.7 Just over half the students identified that six shared electrons were shown in the overlap of energy levels in the diagram representing a molecule of nitrogen. Three pairs would have been an acceptable answer although 3 was a common incorrect answer.

02.8 Only 5% of students were able to select the word from the box to complete the name of the compound with the formula Li_3N. The most common answer was nitrogen. Credit was awarded if the student identified the correct answer in the box, provided this was not contradicted by what was written in the answer space.

02.9 Just under half of students knew that neon does not react with other elements because neon has a stable arrangement of electrons. The most popular incorrect distractor was neon is a non-metallic element.