AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.1.1

Atoms, elements and compounds

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**24**
Available paper years	**2007–2023**

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.

4.1.1.1 Atoms, elements and compounds

Answer 01 · Mark scheme June 2007 | CHY1A | Original Q2 | Legacy

Two	**A**	an alloy	**4**
	B	an element	**1**
	C	a hydrocarbon	**2**
	D	a mixture of compounds	**3**

	A	**B**	**C**	**D**

Answer 02 · Mark scheme November 2007 | CHY1A | Original Q2 | Legacy

Two	**A**	pure iron	**3**
	B	an alloy	**1**
	C	a mixture of compounds	**2**
	D	a mixture of elements	**4**

	A	**B**	**C**	**D**

Answer 03 · Mark scheme January 2008 | CHY1H | Original Q2 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 04 · Mark scheme June 2008 | CHY1AP | Original Q1 | Legacy

One	**A**	C_2H_5OH	**3**
	B	C_3H_8	**2**
	C	C_2H_4	**1**
	D	S	**4**

Answer 05 · Mark scheme June 2008 | CHY1AP | Original Q6 | Legacy

Six	**1**	**2**	**4**	**3**

Answer 06 · Mark scheme June 2008 | CHY1AP | Original Q7 | Legacy

Seven	**3**	**1**	**3**	**3**

4.1.1.1 Atoms, elements and compounds

Answer 07 · Mark scheme November 2008 | CHY1AP | Original Q2 | Legacy

Two	**A** It is a pure metal.			**1**
	B It is the alloy that contains only two metals.			**2**
	C It is a low carbon steel alloy.			**3**
	D It is the alloy that contains the most different elements.			**4**
	A	**B**	**C**	**D**

Answer 08 · Mark scheme June 2009 | CHY1AP | Original Q2 | Legacy

Two	**A** compounds			**3**
	B bonds			**2**
	C products			**1**
	D elements			**4**
	A	**B**	**C**	**D**

Answer 09 · Mark scheme June 2009 | CHY1AP | Original Q7 | Legacy

Seven	**4**	**1**	**4**	**1**

Answer 10 · Mark scheme November 2009 | CHY1AP | Original Q2 | Legacy

Two	**A** Formulae **A** ($ZnCO_3$)			**2**
	B Formulae **B** (C)			**4**
	C Formulae **C** (CO_2)			**3**
	D Formulae **D** (ZnO)			**1**
	A	**B**	**C**	**D**

Answer 11 · Mark scheme June 2010 | CHY1AP | Original Q4 | Legacy

Four	**3**	**4**	**3**	**1**

Answer 12 · Mark scheme November 2010 | CHY1AP | Original Q3 | Legacy

Three	**3**	**4**	**2**	**1**

4.1.1.1 Atoms, elements and compounds

Answer 13 · Mark scheme

June 2012 | CH1HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	protons (**and**) neutrons	both needed for **1** mark ignore p / + and n / 0 do **not** accept electrons	1
1(b)	because the number of protons is equal to the number of electrons	allow protons and electrons balance / cancel out allow positive / + and negative / - balance / cancel out	1
1(c)	because atom A has a full highest energy level **or** full outer shell **or** because atom A has a stable arrangement of electrons	it = atom A allow all the shells are full **or** no incomplete shell allow because atom A is in Group 0 / a noble gas	1
1(d)	(atom) B / lithium / Li (**and**) (atom) C / sodium / Na because they have the same number/one outer electron(s)	both needed for **1** mark linked to answer for first mark accept because both need to lose one / an electron allow because (atoms) B and C are in Group 1 / the same group / are alkali metals	1 1
Total			**5**

4.1.1.1 Atoms, elements and compounds

Answer 13 · Mark scheme June 2012 | CH1HP | Original Q1 | Legacy

CH1HP

4.1.1.1 Atoms, elements and compounds

Answer 14 · Mark scheme June 2015 | CH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	protons	allow “protons or electrons”, but do not allow “protons and electrons”	1	1 / 1.1.1g
1(a)(ii)	protons plus/and neutrons		1	1 / 1.1.1g
1(b)	(because the relative electrical charges are) –(1) for an electron and +(1) for a proton and the number of electrons is equal to the number of protons	allow electrons are negative and protons are positive if no other mark awarded, allow 1 mark for the charges cancel out	1 1	1 / 1.1.1d/e
1(c)	(the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7 (so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell	allow diagrams for the first marking point if no other mark awarded, allow 1 mark for have the same/similar properties	1 1	1+2 / 1.1.1a / 1.1.2a
1(d)	S		1	2 / 1.1.1b
1(e)(i)	ions		1	1 / 1.1.3a
1(e)(ii)	molecules		1	1 / 1.1.3a
Total			**9**	

4.1.1.1 Atoms, elements and compounds

Answer 14 · Mark scheme

June 2015 | CH1HP | Original Q1 | Legacy



4.1.1.1 Atoms, elements and compounds

Answer 15 · Mark scheme

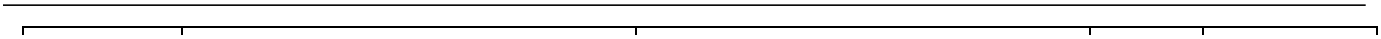
June 2015 | CH3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	Li **and** K	either order allow lithium **and** potassium	1	**AO1** 3.1.3.a
1(b)	Fe	allow iron	1	**AO1** 3.5.1.b
1(c)	N **and** As	either order allow nitrogen **and** arsenic	1	**AO2** 3.1.2.b
1(d)	Cu	allow copper	1	**AO1** 3.1.3.d
Total			**4**	

4.1.1.1 Atoms, elements and compounds

Answer 15 · Mark scheme

June 2015 | CH3HP | Original Q1 | Legacy



4.1.1.1 Atoms, elements and compounds

Answer 16 · Mark scheme

June 2016 | CH1HP | Original Q1 | Legacy

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	electronic structure 2,3 drawn	allow any representation of electrons, such as, dots, crosses, or numbers (2,3)	1	AO2 1.1.1h
1(a)(ii)	nucleus		1	AO1 1.1.1c
1(a)(iii)	protons and neutrons (relative charge of proton) +1 (relative charge of neutron) 0	do **not** allow electrons in nucleus allow positive allow no charge/neutral ignore number of particles	1 1 1	AO1 1.1.1c/d/f
1(b)	too many electrons in the first energy level or inner shell too few electrons in the second energy level or outer shell neon does not have 9 electrons **or** neon has 10 electrons	allow inner shell can only have a maximum of 2 electrons allow neon has 8 electrons in its outer shell **or** neon does not have 1 electron in its outer shell allow neon has a stable arrangement of electrons or a full outer shell allow one electron missing allow fluorine has 9 electrons ignore second shell can hold (maximum) 8 electrons or 2,8,8 rule or is a noble gas or in Group 0 max 2 marks if the wrong particle, such as atoms instead of electrons if no other mark awarded allow 1 mark for the electronic structure of neon is 2,8	1 1 1	AO2+AO3 1.1.1h; 1.1.2b
Total			8	

4.1.1.1 Atoms, elements and compounds

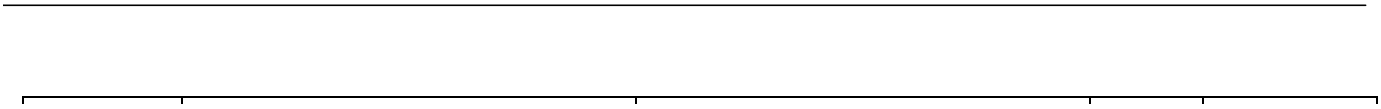
Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	same number of protons **or** 12 protons in each	ignore electrons ignore it is the same element do **not** allow same number of neutrons	1	**AO2** 1.1.1f,g
1(a)(ii)	(the mass number is) the sum of the protons and neutrons (so the atoms contain) different numbers of neutrons	ignore electrons in shells do **not** allow electrons in nucleus allow 12, 13 and 14 neutrons for two marks if no other mark awarded allow one mark for isotopes	1 1	**AO1** **AO2** 1.1.1g
1(b)(i)	3 / three		1	**AO2** 1.1.3a,b
1(b)(ii)	7 / seven		1	**AO2** 1.1.3a,b
1(c)	319 g($CuSO_4$) and 36 g(H_2O)		1	**AO3** 1.1.3b,c
1(d)	any **two** changes from: • limewater turns cloudy • solution turns blue • mass decreases • copper carbonate **or** (green) solid disappears • bubbles / fizzing / effervescence explanation: because carbon dioxide is produced **or** copper sulfate is produced **or** calcium carbonate is produced	allow milky / white allow weight decreases explanation must be linked to their observation	2 1	**AO1** **AO2** **AO3** 1.2.1e,f
Total			**9**	

4.1.1.1 Atoms, elements and compounds

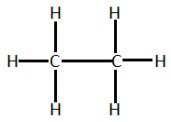
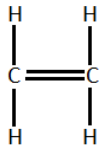
Answer 17 · Mark scheme

June 2017 | CH1HP | Original Q1 | Legacy



4.1.1.1 Atoms, elements and compounds

Answer 18 · Mark scheme June 2017 | CH1HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	electronic structure drawn	allow any representation of an electron allow 2,4	1	**AO2** 1.1.1h
2(a)(ii)	six / 6 protons (protons) are positively charged	 do **not** allow electrons in nucleus otherwise ignore electrons do **not** allow nucleus is neutral allow (protons are) + / +1 / 1+ ignore statements about mass if no other mark awarded allow one mark for nucleus	1 1 1	**AO1** **AO2** 1.1.1c;d;e
2(b)	(a hydrocarbon is) made up of hydrogen and carbon (atoms) only	do **not** allow mixture	1	**AO1** 1.4.1a;c
2(c)(i)	 	ethane correctly drawn with another hydrogen on each carbon and another three single bonds ethene correctly drawn with a double bond between the carbon atoms	1 1	**AO1** 1.4.2a 1.5.1c
2(c)(ii)	as the number of carbon atoms increases the boiling point increases	allow converse ignore alkene	1	**AO3** 1.4.2c

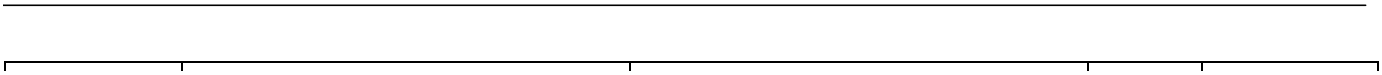
Answer 18 · Mark scheme

2(c)(iii)	the boiling points of alkanes are higher than the boiling points of alkenes that have the same number of carbon atoms **or** state a correct example	allow the boiling points of alkenes are lower than the boiling points of alkanes consequential on first marking point e.g. hexane has a higher boiling point than hexene **or** hexane boils at 69ºC hexene boils at 64ºC if no other mark awarded allow both alkanes and alkenes have the same pattern of the more carbon atoms the higher the boiling point for one mark	1 1	**AO2** 1.4.2b;c
2(d)	(alkane molecules are) cracked to produce small(er) molecules / alkanes / hydrocarbons and alkenes **or** a named alkene	allow break down / up **or** decompose **or** split up ignore separate allow short chain for small allow molecules that have a double bond **or** are unsaturated if no other mark awarded allow evaporate **or** boil for one mark ignore turns to gas	1 1 1	**AO1** **AO2** **AO3** 1.5.1a;b;d
Total			**13**	

4.1.1.1 Atoms, elements and compounds

Answer 18 · Mark scheme

June 2017 | CH1HP | Original Q2 | Legacy



4.1.1.1 Atoms, elements and compounds

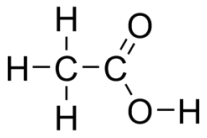
Answer 19 · Mark scheme

June 2017 | CH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	any **one** from: • for undiscovered elements • so elements with similar properties were in same column / group	ignore so they fit the pattern	1	**AO1** 3.1.1b
3(a)(ii)	any **one** from: • they have different properties from elements above them • they are (transition) metals .	ignore electronic configuration ignore they did not fit the pattern allow transition elements	1	**AO1** 3.1.1a,b
3(b)(i)	7 electrons in outer shell / highest energy level	ignore gain of 1 electron	1	**AO2** 3.1.2b
3(b)(ii)	for bromine: outer shell closer to nucleus stronger force of attraction (to nucleus) electron more easily gained to outer shell	'outer' must be mentioned once for 3 marks. comparatives required. ignore references to bromide / iodide allow converse for iodine allow fewer shells allow smaller atom allow less shielding	1 1 1	**AO1** **AO2** 3.1.3g,h

4.1.1.1 Atoms, elements and compounds

Answer 19 · Mark scheme

3(c)(i)	yellow precipitate	allow yellow or dark yellow or light yellow or pale yellow allow dark yellow or light yellow or pale yellow precipitate allow dark yellow or light yellow or pale yellow ppt allow dark yellow or light yellow or pale yellow solid do **not** allow yellow solution	1	**AO1** 3.4.1e
3(c)(ii)	green precipitate	allow green or dark green or light green or pale green or dirty green allow dark green or light green or pale green or dirty green precipitate allow dark green or light green or pale green or dirty green ppt allow dark green or light green or pale green or dirty green solid do **not** allow green solution	1	**AO1** 3.4.1b
3(d)	one colour obscures the other	allow colours mix / blend allow only one colour seen	1	**AO3** 3.4.1a
3(e)(i)		allow -OH in the structure without the -O-H bond shown	1	**AO1** 3.6.2a

4.1.1.1 Atoms, elements and compounds

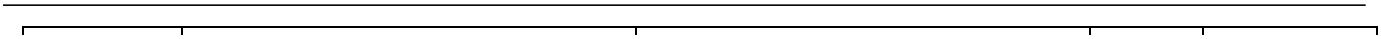
Answer 19 · Mark scheme

3(e)(ii)	weak acid (because) ethanoic acid is not fully ionised / dissociated	allow converse for hydrochloric acid allow (the solution) has a lower concentration of hydrogen ions allow (produces) fewer hydrogen ions. do **not** allow ionising	1 1	**AO3** 3.6.2a,b
Total			**12**	

4.1.1.1 Atoms, elements and compounds

Answer 19 · Mark scheme

June 2017 | CH3HP | Original Q3 | Legacy



4.1.1.1 Atoms, elements and compounds

Answer 20 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
02.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
02.3	any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.1.1.1 Atoms, elements and compounds

Answer 20 · Mark scheme

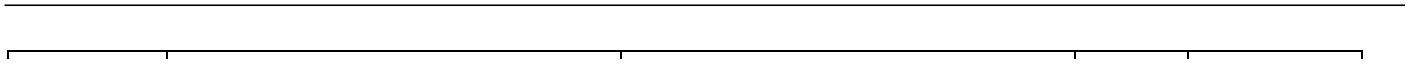
June 2018 | 8462/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	carbon is more reactive (than nickel) (so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow converse allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1 1	AO1 4.4.1.2 4.4.1.3
02.5	(total M_r of reactants =) 87 (percentage atom economy) $= \frac{59}{87} \times 100$ = 67.8 (%)	an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$ allow an answer from an incorrect calculation to 3 sig figs	1 1 1	AO2 4.3.3.2
Total			**11**	

4.1.1.1 Atoms, elements and compounds

Answer 20 · Mark scheme

June 2018 | 8462/1H | Original Q2



4.1.1.1 Atoms, elements and compounds

Answer 21 · Mark scheme

November 2021 | 8462/1H | Original Q4

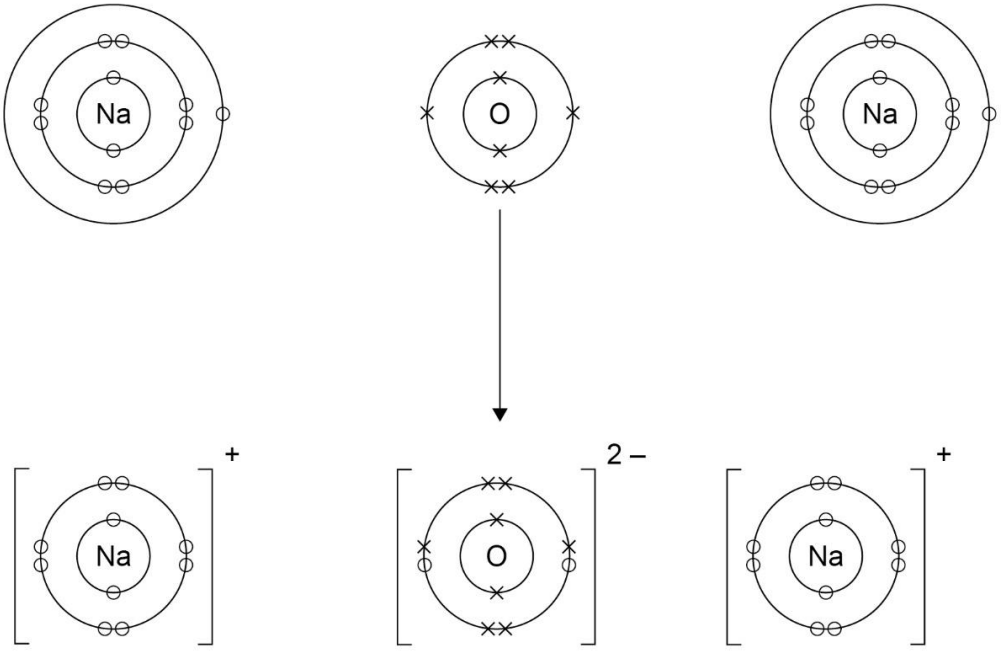
Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** from: • (potassium) floats • (potassium) melts • (potassium) moves around • potassium becomes smaller • (lilac) flame • effervescence	 allow potassium disappears allow fizzing	2	AO1 4.1.2.5 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$2K + 2H_2O \rightarrow 2KOH + H_2$	allow multiples allow **1** mark for KOH **and** H_2	2	AO1 AO2 4.1.1.1 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	reactivity increases (going down the group) (because) the outer electron / shell is further from the nucleus (so) there is less attraction between the nucleus and the outer electron / shell (so) the atom loses an electron more easily	 allow (because) there are more shells allow (because) the atoms get larger allow (so) there is more shielding from the nucleus do **not** accept incorrect attractions	1 1 1 1	AO1 4.1.2.5 4.4.1.2

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(dot and cross diagram to show) sodium atom **and** oxygen atom	allow use of outer shells only	1	AO2 4.2.1.1 4.2.1.2
	two sodium atoms to one oxygen atom	allow two sodium ions to one oxide ion	1	
	(to produce) sodium ion with a + charge		1	
	(to produce) oxide ion with a 2– charge		1	
	 scores **4** marks			

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(oxygen) gains electrons		1	AO1 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	giant structure	allow (giant ionic) lattice	1	AO1 4.2.1.3 4.2.2.1
	(with) strong (electrostatic) forces of attraction between (oppositely charged) ions		1	4.2.2.3
	(so) large amounts of energy are needed to break the bonds / forces	allow (so) large amounts of energy are needed to separate the ions	1	

Total			**16**

4.1.1.1 Atoms, elements and compounds

Answer 22 · Mark scheme

November 2021 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	ammonium phosphate potassium nitrate		1 1	AO2 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(nitric acid) calcium nitrate (phosphoric acid) (calcium) triple superphosphate **or** calcium dihydrogenphosphate		1 1	AO1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	 (industrial process) (is) large(er) scale (is) quicker (is a) continuous process reasoned judgement	allow converse for laboratory process ignore references to cost / energy ignore large mass produced	 1 1 1 1	AO3 4.10.4.2

Total			8

4.1.1.1 Atoms, elements and compounds

Answer 23 · Mark scheme

June 2023 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a ball of positive charge with (negative) electrons embedded	do **not** accept references to protons, nuclei, neutrons	1 1	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(earliest) electrons protons (latest) neutrons		1	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(number of outer shell electrons) 7 (reason) (tennessine is in) Group 7	 allow the number of outer electrons is the same as the group number allow tennessine is a halogen MP2 is dependent on MP1 being awarded	1 1	AO2 4.1.2.1 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(time needed for) peer review	allow the idea that other scientists had to check the results	1	AO3 4.1.2.2

4.1.1.1 Atoms, elements and compounds

Answer 23 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(A_r =) $\frac{(6 \times 7.6) + (7 \times 92.4)}{100}$	allow $\frac{45.6 + 646.8}{100}$ allow (6 × 0.076) + (7 × 0.924) allow 0.456 + 6.468	1	AO2 4.1.1.6
	= 6.924		1	
	= 6.9	allow an answer correctly rounded to 1 decimal place from an incorrect calculation which uses all the data in the table	1	

Total Question 1	9

4.1.1.1 Atoms, elements and compounds

Answer 24 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(atoms of) argon have a stable arrangement of electrons (so) argon (atoms) do not share / transfer electrons	allow (atoms of) argon have a full outer shell (of electrons)	1 1	AO1 4.1.2.3 4.1.2.4 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	PH_3	allow H_3P	1	AO2 4.1.2.1 4.2.1.4

4.1.1.1 Atoms, elements and compounds

Answer 24 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3		MP2 is dependent upon MP1 being awarded		AO3 4.1.2.3
	yes, because tellurium is towards the right of the periodic table	allow yes, because tellurium is in Group 6	1	
	(so) tellurium is a non-metal	allow (so) tellurium will gain electrons (from a metal)	1	
	OR			
	yes, because tellurium is in the same group as oxygen / sulfur (1)			
	(and) oxygen / sulfur will react with metals (1)	allow (so) tellurium is a non-metal allow (so) tellurium will gain electrons (from a metal)		
	OR			
	no, because tellurium is towards the bottom of the periodic table (1)			
	(so) tellurium is a metal (1)	allow (so) difficult for tellurium to gain electrons (from a metal) (1)		
	OR			
	cannot predict as tellurium is towards the bottom and to the right of the periodic table (1)			
	(so) don't know whether tellurium is a metal or non-metal (1)	allow (so) don't know whether tellurium will gain electrons		

Answer 24 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	any **two** from: • effervescence / fizzing / bubbles • barium disappears • forms a colourless solution • temperature increases	ignore references to floating / flames ignore produces a gas allow barium gets smaller allow barium moves around	2	AO3 4.1.2.1 4.4.1.2 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	$Ba + 2\ HCl \rightarrow BaCl_2 + H_2$	allow multiples allow **1** mark for $BaCl_2$ allow **1** mark for H_2 ignore state symbols	3	AO2 4.1.1.1 4.4.1.2 4.4.2.1

Total Question 8	10

Answer 20 · Examiner comments

June 2018 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 Because the question asked for the formula rather than the empirical formula, an answer of Fe_9S_{18} was accepted. Even so, 51% of students could not count the atoms and produce a ratio of 1:2. A formula was required, not an equation which some students provided.

02.2 This was very well answered, with 88% of students achieving all three marks.

02.3 57% of students achieved both marks. However, some repeated information in the stem of the question, and some contradicted it by saying sodium is not a metal. Some gave differences in the structure of the atoms instead of differences in properties of the substances.

02.4 This was well answered, with 32% of students achieving one mark, and 57% achieving both.

A common error was to say that carbon is reacting with oxygen (it is not; it is reacting with nickel oxide to remove the oxygen). Those who tried to answer in terms of electron transfer often struggled to gain all the marks.

Answer 20 · Examiner comments

June 2018 | 8462/1H | Original Q2

02.5 This question was well answered, with 60% of students achieving all three marks. However, interpretation of calculator displays did cause a bit of trouble for some students. Some students lost the final mark because they gave an answer of 67.$\dot{8}$. This answer is neither correct (it is not 67.8888888…) nor to three significant figures (it is to an infinite number of significant figures). Some even recognised this latter point and rounded, incorrectly, to 67.9.

4.1.1.1 Atoms, elements and compounds

Answer 21 · Examiner comments November 2021 | 8462/1H | Original Q4

Question 4 (standard, standard / high and high demand)

04.1 Many students remembered that effervescence would be seen, but there were many vague descriptions such as 'vigorous reaction' which did not gain credit. Students often gave the same observation twice, eg, 'effervescence' and 'bubbles'. Many students incorrectly mentioned a colour change, perhaps remembering a demonstration where an indicator had been added. Very few mentioned the potassium melting.

04.2 Very few students could write the formulae for the correct products. Those who could were usually able to balance the equation. Many students approached the question from the wrong direction, trying to balance the equation by inventing fictitious products.

04.3 This was not well answered, with only a small number of students scoring full marks. Many incorrectly tried to link reactivity to melting and boiling point. Many referred to the distance and / or attraction between the nucleus and electrons in general, rather than the outer electrons. Others failed to mention the nucleus at all.

04.4 The electron arrangements of both atoms and ions were required for full marks, as well as the ratio of sodium ions to oxide ions and the correct charges on the ions. Few students scored all the marks as they did not draw the atoms of sodium and oxygen before reaction. Many tried to draw covalent structures. The ratio of 2 atoms of sodium to one of oxygen was well known. Students should be aware that electrons cannot be in two places at the same time and should not be drawn as if they are. Some students drew both ionic and covalent structures, thereby contradicting themselves and losing the marks for a correct ionic structure. A great deal of time and effort would be saved by drawing the outer electrons only, as in the specification.

04.6 Students found this question very difficult, with many referring incorrectly to intermolecular forces, even when mentioning ions. Many also referred to covalent bonds or forces between atoms. Of those who did refer correctly to the large amounts of energy required to break the strong attractions between ions, very few referred to the giant structure of the compound.

Answer 22 · Examiner comments November 2021 | 8462/2H | Original Q5

Question 5 (standard / high and high demand)

05.1 Nearly four-fifths of students identified one salt, while more than a third worked out both.

05.2 Around two-thirds of students could identify calcium nitrate.

05.3 Two marks were usually easily scored, often for ideas relating to a quicker or continuous process. Four marks were almost never awarded, because students did not appear to appreciate the need for a reasoned judgement when the command word is 'evaluate'.

4.1.1.1 Atoms, elements and compounds

Answer 23 · Examiner comments — June 2023 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 Only two fifths of students scored both marks, although three quarters scored at least one mark. The plum pudding model is described in the specification. However, some students referred to a ball of positive energy rather than positive charge, and some did not name the electrons, or implied that they were outside the positive ball rather than embedded in it.

01.2 Nearly three fifths of students could give the correct order of discovery.

01.3 More than three quarters of students scored both marks by locating tennessine in Group 7 and therefore deducing that it has 7 outer shell electrons. Some ignored the instruction to use the periodic table and tried unsuccessfully to work out the electron configuration.

01.4 Only one fifth of students were familiar with the idea of peer review or could apply it to this situation. A common incorrect reason was the scarcity of the element; this was the same for the original group of scientists so does not explain the delay.

01.5 Two thirds of students gave fully correct answers, and the question discriminated well. The great majority scored at least one mark, for giving an attempt at the calculation to one decimal place. Some divided by the sum of the mass numbers instead of the sum of the percentages (ie 100). There were very few rounding errors. Some students did not realise

Answer 23 · Examiner comments — June 2023 | 8462/1H | Original Q1

that their answer must lie somewhere between 6 and 7, the two mass numbers of the isotopes.

Answer 24 · Examiner comments

June 2023 | 8462/1H | Original Q8

Question 8 (standard, standard/high and high demand)

08.1 This question was well answered, with nearly all students referencing the stability of the outer electron shell. 'Full outer shell' was accepted even though it is not strictly true for a Period 3 element. About a half of students also referred to the lack of ability to share or transfer electrons, but some simply repeated that argon does not form compounds or does not form bonds. This was insufficient as the question required students to answer in terms of electrons.

08.2 About three fifths of students were able to give a correct formula by analogy with ammonia. PH_2 was a common incorrect response.

08.3 More than two fifths of students scored both marks, with nearly two thirds scoring at least one. Those who failed to score usually did not answer in terms of the position in the periodic table, as required. Students could reference the position on the right, and/or towards the bottom, or in Group 6 (the most common answer) to deduce whether or not a reaction would occur. However, many just stated that tellurium has six electrons in its outer shell, without mentioning the position.

08.4 About two thirds of students scored one mark, but far fewer were able to give a second valid observation. The most common observation was effervescence / bubbling / fizzing, but sometimes students used two of these words as if they were separate observations. Students sometimes gave deductions (gas produced, heat produced) instead of the actual observation (bubbling, temperature increase). Other common errors were to give observations which might be seen in any chemical change (eg formation of a precipitate, or a colour change) rather than this specific one.

08.5 Over a third of students scored at least two marks on this high demand question, with most of these students scoring all three marks. Nearly three quarters scored one mark, usually for the formula H_2. Those students who managed to work out the correct formula for barium chloride often scored all three marks. Some students were unable to work out that barium chloride and hydrogen would be the products. It was not uncommon to see the wrong symbol for barium, despite its being given at the top of the page.