AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.2.4

Group 0

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**30**
Available paper years	**2007–2025**

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.

4.1.2.4 Group 0

Answer 01 · Mark scheme June 2007 | CHY1B | Original Q5 | Legacy

Five	**2**	**4**	**3**	**3**

Answer 02 · Mark scheme June 2007 | CHY1H | Original Q3 | Legacy

The full source mark scheme begins on page 43. Follow original question 3 in that document.

Answer 03 · Mark scheme November 2007 | CHY1A | Original Q6 | Legacy

Six	**3**	**3**	**2**	**3**

Answer 04 · Mark scheme March 2008 | CHY1BP | Original Q5 | Legacy

Five	**3**	**3**	**3**	**2**

Answer 05 · Mark scheme November 2008 | CHY1BP | Original Q1 | Legacy

One	**A**	carbon dioxide	**3**
	B	helium	**1**
	C	nitrogen	**2**
	D	oxygen	**4**

Answer 06 · Mark scheme June 2009 | CHY1BP | Original Q8 | Legacy

Eight	**1**	**4**	**4**	**3**

4.1.2.4 Group 0

Answer 07 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)(i)	(gases from) volcanoes		1
3(a)(ii)	100	allow 99	1
3(a)(iii)	any **two** from: • photosynthesis • carbon dioxide used • oxygen produced	they = plants allow carbon dioxide decreased allow oxygen increased ignore nitrogen / respiration	2
3(b)(i)	any **one** from: • sea floor spreading • periodic measurements between continents • evidence from rocks / fossils on different continents • new mountain ranges	 accept oceanic ridges / magnetic stripes accept continents move a few centimetres each year accept continents fit together accept new islands	1
3(b)(ii)	in the mantle any **two** from: • convection (currents) / movement • radioactivity / radioactive decay / nuclear reactions • releases heat / thermal energy	 do **not** accept movement of the plates accept heat from core	1 2
Total			**8**

4.1.2.4 Group 0

Answer 07 · Mark scheme

June 2009 | CHY1H | Original Q3 | Legacy

CHY1H

4.1.2.4 Group 0

Answer 08 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)	gas / carbon dioxide / CO_2 (produced / released)	ignore how gas is formed	1
7(b)	any **two** from: • calcium oxide / CaO / quicklime (is the solid) • (calcium oxide) reacts with water **or** carbon dioxide • argon would not react	 accept reacts to form calcium hydroxide / calcium carbonate	2

Question 7 continues on the next page

CHY1H

Question 7 continued

question	answers	extra information	mark
7(c)	for full marks: candidates should consider and explain **four** of the following points: **1 Wood / habitats** – • screening / use of wood • damage to habitat **2 Town (proximity) -** • noise / visual / dust pollution / damage / subsidence **3 Labour force-** • proximity to site (travelling time / use of fuel / carbon footprint) **4 River** - • pollution due to nearness **5 Transport (of materials)** – • (nearness to road / railway) **6 Quality of limestone** – • (best D – C – A – B worst) • amount of waste **7 Wind direction** – • carries dust, noise, fumes etc towards town • (only B & D are directly downwind of town)	for full marks candidates must have at least **one** advantage and **one** disadvantage allow only one advantage / disadvantage for each point **but** each point could be correctly explained as an advantage **and** a disadvantage for **2** marks ignore issues common to all sites eg scarring the landscape / area of natural beauty ignore comments about sites other than the one chosen unless a comparison is made ignore pollution unless explained	max 4
Total			**7**

4.1.2.4 Group 0

Answer 09 · Mark scheme

March 2010 | CHY1BP | Original Q8 | Legacy

Eight	**2**	**1**	**2**	**1**

4.1.2.4 Group 0

Answer 10 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	removal of oxygen	accept definition in terms of electrons **or** oxidation numbers ignore oxides	1
4(a)(ii)	2 (Cl_2)	allow correct multiples	1
4(a)(iii)	no atoms are lost / made (during a chemical reaction) **or** the atoms are rearranged (during a chemical reaction)	accept because of (the law of) conservation of mass / matter	1
4(b)(i)	sodium is more reactive (than titanium)	accept sodium is very reactive **or** titanium is less reactive do **not** accept sodium is more reactive than argon	1
4(b)(ii)	any **one** from: • sodium / titanium would react with oxygen / air • sodium / titanium does not react with argon	 accept air / oxygen is reactive accept argon is unreactive / inert / a noble gas / in group O	1
4(c)(i)	all atoms are the same / it only contains one type of atom	accept all ions are the same do **not** accept only got one atom do **not** accept all atoms are the same size ignore particles	1
4(c)(ii)	two different / types atoms / elements / ions bonded / joined together	accept more than one type of atom / ion / element do **not** accept different size accept definite proportions do **not** accept mixture	1 1
Total			**8**

4.1.2.4 Group 0

Answer 10 · Mark scheme January 2011 | CHY1H | Original Q4 | Legacy

CHY1H

Answer 11 · Mark scheme March 2011 | CHY1BP | Original Q5 | Legacy

Five	**3**	**1**	**2**	**2**

Answer 12 · Mark scheme June 2011 | CHY1BP | Original Q3 | Legacy

Three	**3**	**3**	**3**	**2**

Answer 13 · Mark scheme June 2011 | CHY1BP | Original Q9 | Legacy

Nine	**3**	**3**	**3**	**3**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

Answer 14 · Mark scheme November 2011 | CHY1AP | Original Q7 | Legacy

Seven	**1**	**2**	**2**	**3**

Answer 15 · Mark scheme November 2011 | CHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	abundance	**4**
	B	colour	**2**
	C	density	**3**
	D	reactivity	**1**

4.1.2.4 Group 0

Answer 16 · Mark scheme

November 2011 | CHY1BP | Original Q6 | Legacy

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

4.1.2.4 Group 0

Answer 17 · Mark scheme

June 2012 | CH1HP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	any **one** from: • there are many stages needed (to extract titanium) • more energy / materials are needed (to extract titanium) • titanium cannot be extracted by using carbon	ignore references to cost / mining / availability allow longer / slower / more complicated process / batch process ignore higher temperature ignore reference to electrolysis do **not** accept titanium extracted by electrolysis	1
2(b)	carbon dioxide	allow CO_2	1
2(c)	magnesium chloride is electrolysed / used / decomposed magnesium and / or chlorine are recycled / reused	 allow the products of electrolysis are recycled word / symbol equation = **1** mark	1 1
2(d)	 because oxygen / nitrogen (in air) would react with the magnesium **or** would produce magnesium oxide / nitride whereas argon is inert / unreactive **or** argon does not react (with magnesium)	accept titanium for magnesium ignore argon is in Group 0 / noble gas	 1 1
2(e)	240		1
2(f)	250	allow range 245 to 250	1
Total			**8**

4.1.2.4 Group 0

Answer 17 · Mark scheme

June 2012 | CH1HP | Original Q2 | Legacy

CH1HP

4.1.2.4 Group 0

Answer 18 · Mark scheme

June 2012 | CH1HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	because the nitrogen from dry air contained noble/Group 0 gases **or** (because the nitrogen from dry air) contained argon / krypton / xenon and three / some of these gases, (argon, krypton, xenon) have a greater density than nitrogen **or** and argon / krypton / xenon has a greater density than nitrogen	ignore other gases ignore helium and neon ignore helium and neon	1 1
8(b)(i)	carbon dioxide would form / is a solid **or** (solid) carbon dioxide would block pipes	accept carbon dioxide freezes or its freezing point is > –200°C ignore melting point	1
8(b)(ii)	helium (**and**) neon	both needed for **1** mark accept He and Ne	1
8(b)(iii)	argon (**and**) oxygen because there is only a difference of 3 °C in their boiling points	accept Ar and O_2 accept because they have boiling points that are almost the same	1 1
Total			**6**

UMS Conversion Calculator www.aqa.org.uk/umsconversion

4.1.2.4 Group 0

Answer 19 · Mark scheme

question	answers	extra information	mark
1(a)	hydrogen has one proton whereas helium has two protons	accept numbers for words accept hydrogen only has one proton ignore references to groups	1
	hydrogen has one electron whereas helium has two electrons	accept hydrogen only has one electron allow helium has a full outer shell (of electrons)	1
	hydrogen has no neutrons **or** helium has two neutrons	if no other mark awarded, allow helium has more electrons / protons / neutrons for **1** mark	1
1(b)(i)	2 electrons on first shell **and** 8 electrons on outer shell		1
1(b)(ii)	they have a stable arrangement of electrons	accept they have full outer energy level/shell of electrons do **not** accept they have the same number of electrons in their outer energy level / shell allow they are noble gases ignore they are in group 0	1
Total			**5**

4.1.2.4 Group 0

Answer 19 · Mark scheme

January 2013 | CH1HP | Original Q1 | Legacy

CH1HP

4.1.2.4 Group 0

Answer 20 · Mark scheme

question	answers	extra information	mark
7(a)	(because to produce low-carbon steel) oxygen is needed to react with / oxidise carbon	accept (to produce low-carbon steel) oxygen removes carbon as carbon dioxide	1
	(to produce titanium) an atmosphere of argon is used because it is unreactive		1
	any oxygen / air would react with / oxidise magnesium or titanium	ignore magnesium chloride / titanium chloride reacts with oxygen	1
7(b)		it = titanium ignore references to abundance / usefulness / temperature / amounts / relative reactivity / equipment	
	for titanium:	allow converse arguments for iron	
	• there are more stages in its manufacture	accept slower rate of production **or** is more labour intensive **or** a batch process is used or the process used is not continuous	1
	• larger amounts of energy are needed	accept the titanium chloride is cooled and reheated which is not energy efficient	1
	• magnesium / chlorine / argon have to be produced **or** are expensive **or** are used		1

4.1.2.4 Group 0

CH1HP

question	answers	extra information	mark
7(c)	titanium is below magnesium and above iron (in the reactivity series of metals)	allow similar position to aluminium **or** carbon **or** zinc	1
	because magnesium removes chlorine from titanium chloride **and** titanium removes oxygen from iron oxide **OR** magnesium more reactive than titanium because it removes chlorine from titanium chloride (1) titanium more reactive than iron because it removes oxygen from iron oxide (1)	allow magnesium displaces titanium **and** titanium displaces iron accept magnesium more reactive than titanium because it displaces titanium accept titanium more reactive than iron because it displaces iron	1
Total			**8**

4.1.2.4 Group 0

Answer 20 · Mark scheme

January 2013 | CH1HP | Original Q7 | Legacy

CH1HP

4.1.2.4 Group 0

Answer 21 · Mark scheme

January 2013 | CH1HP | Original Q8 | Legacy

question	answers	extra information	mark
8(a)	methane		1
	because at the surface temperature of -179°C only methane has melted but has not boiled	accept a correct explanation using the boiling points(and melting points) of the gases **or** methane is a liquid **and** all the others are gases	1
8(b)	CH_4 is a hydrocarbon **or** methane / carbon monoxide contains carbon **or** carbon monoxide + hydrogen → hydrocarbon		1
	nitrogen **and** hydrogen are present in Titan's atmosphere **or** nitrogen + hydrogen → ammonia		1
	carbon monoxide contains oxygen **or** carbon monoxide + hydrogen / methane → water		1
	amino acids contain carbon, hydrogen, nitrogen + oxygen **or** amino acids can be made from (methane), hydrogen, carbon monoxide and nitrogen **OR** lightning / ultraviolet / electrical discharge / high energy needed for reaction		1
Total			**6**

UMS conversion calculator www.aqa.org.uk/umsconversion

4.1.2.4 Group 0

Answer 22 · Mark scheme June 2014 | CH1HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
6(a)(i)	*Wegener / they* could not explain how continents could move	*allow not enough or no evidence or no proof (of movement)* *ignore status / technology*	1	1 / 1.7	E
6(a)(ii)	*because the (Earth's) crust* *(is divided into tectonic) plates* *the heat (released) from radioactive processes* *causes convection currents* *in the mantle (that move the tectonic plates)*		1 1 1 1 1	1 / 1.7.1b/c	E
6(b)(i)	forms a solid **or** freezes	accept would block pipes	1	2 / 1.7.2j	E
6(b)(ii)	neon		1	2 / 1.7.2j	A
6(b)(iii)	argon because the boiling points are almost the same **or** only 3 degrees different	*do **not** allow reference to melting points*	1 1	3 / 1.7.2j	E
Total			**10**		

4.1.2.4 Group 0

Answer 22 · Mark scheme

June 2014 | CH1HP | Original Q6 | Legacy



4.1.2.4 Group 0

Answer 23 · Mark scheme

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	

4.1.2.4 Group 0

Answer 24 · Mark scheme

June 2017 | CH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	any **one** from: • all these gases / hydrogen / methane / water vapour / ammonia may not have been in the Earth's early atmosphere • the conditions of the reaction were not like those on early Earth • many different amino acids are needed for life processes	ignore no proof / evidence **or** no one was there **or** references to religion **or** meteorites / comets. allow nobody knows what was in the Earth's early atmosphere allow very little (0.5%) in the Earth's early atmosphere allow nobody knows what the conditions were on early Earth allow only simple amino acids **/** glycine were produced	1	**AO3** 1.7.2d;e
5(a)(ii)	any **three** from: • used by plants / algae **or** for photosynthesis • absorbed / dissolved by oceans • locked up in sedimentary rocks / carbonates / limestone • locked up in fossil fuels	ignore volcanoes allow stored in for locked up allow stored in for locked up mention of respiration: maximum two marks	3	**AO1** 1.7.2f;g;h
5(b)(i)	helium / He **and** neon / Ne	both needed	1	**AO2** 1.7.2j

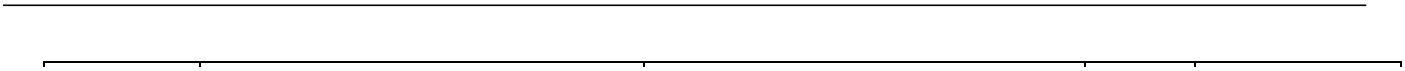
4.1.2.4 Group 0

5(b)(ii)	carbon dioxide would be solid **or** would block pipes	ignore freezes allow forms dry ice	1	**AO3** 1.7.2j
5(b)(iii)	 the other gas is argon / Ar because they have similar boiling points **or** there is only 3 °C difference in boiling points	mark independently	 1 1	**AO2** 1.7.2j
5(c)	 **stage 1:** oxygen reacts with carbon so carbon content decreases **or** carbon forms carbon dioxide **stage 2:** (other metals added) to form an alloy so the steel has a specific property / specific use	mark independently allow because cast iron is (too) brittle allow to stop layers sliding allow because pure iron is (too) soft	 1 1 1 1	**AO1** **AO2** 1.3.2a;b;c
Total			**12**	

4.1.2.4 Group 0

Answer 24 · Mark scheme

June 2017 | CH1HP | Original Q5 | Legacy



4.1.2.4 Group 0

Answer 25 · Mark scheme

June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	chlorine is toxic	allow carbon monoxide is toxic allow poisonous for toxic ignore harmful / deadly / dangerous allow a poisonous gas is used / produced allow titanium chloride is corrosive	1	AO3 4.1.2.6 4.4.1.3
08.2	any **one** from: • very exothermic reaction • produces a corrosive solution • produces hydrogen, which is explosive / flammable	allow explosive allow violent reaction ignore vigorous reaction ignore sodium is very reactive allow caustic for corrosive ignore alkaline allow flames produced ignore sodium burns	1	AO3 4.1.2.5 4.4.1.3
08.3	argon is unreactive / inert oxygen (from air) would react with sodium / titanium **or** water vapour (from air) would react with sodium / titanium	allow argon will not react (with reactants / products / elements) allow elements / reactants / products for sodium / titanium	1 1	AO3 4.1.2.4 4.1.2.5 4.4.1.1 4.4.1.3

4.1.2.4 Group 0

Answer 25 · Mark scheme

June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	metal chlorides are usually ionic	allow titanium chloride is ionic	1	AO1 4.1.2.6 4.1.3.1
	(so)(metal chlorides) are solid at room temperature **or** (so)(metal chlorides) have high melting points	allow titanium chloride for metal chlorides	1	4.2.1.2 4.2.2.3 4.2.2.4
	(because) they have strong (electrostatic) forces between the ions **or** (but) must be a small molecule or covalent	ignore strong ionic bonds allow molecular allow alternative approach: titanium chloride must be covalent **or** has small molecules (1) with weak forces between molecules do **not** accept bonds unless intermolecular bonds(1) (but) metal chlorides are usually ionic (1)	1	
08.5	sodium (atoms) lose electrons	do **not** accept references to oxygen	1	AO1 4.4.1.4
08.6	Na → $Na^+ + e^-$	do **not** accept e for e^-	1	AO2 4.1.1.1 4.4.1.4

4.1.2.4 Group 0

Answer 25 · Mark scheme

June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	(M_r of $TiCl_4$ =) 190 (moles Na) = $\frac{20\,000}{23}$ =) 870 (mol $\left(\text{moles } TiCl_4 = \frac{40\,000}{190} =\right)$ 211 (mol) **either** (sodium is in excess because) 870 mol Na is more than the 844 mol needed **or** (because) 211 mol $TiCl_4$ is less than the 217.5 mol needed	an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps allow **1** mark for 0.870 mol Na **and** 0.211 mol $TiCl_4$ allow use of incorrectly calculated M_r from step 1 the mark is for correct application of the factor of 4 other correct reasoning showing, with values of moles or mass, an excess of sodium or insufficient $TiCl_4$ is acceptable allow use of incorrect number of moles from steps 2 and / or 3 alternative approaches: **approach 1:** (M_r of $TiCl_4$ =) 190(1) (40 kg $TiCl_4$ needs) $\frac{40}{190} \times 4 \times 23$ (kg Na) (1) (=) 19.4 (kg) (1) so 20 kg is an excess (1) **approach 2:** (M_r of $TiCl_4$ =) 190(1) (20 kg Na needs) $\frac{20}{4 \times 23} \times 190$ (kg $TiCl_4$) (1) (=) 41.3 (kg) (1) so 40 kg is not enough (1)	1 1 1 1	AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4

4.1.2.4 Group 0

Answer 25 · Mark scheme

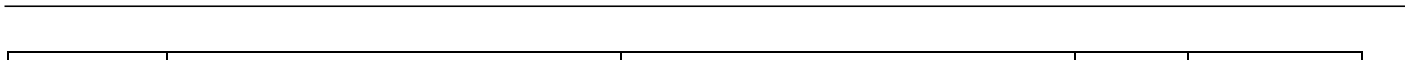
June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	(actual mass =) $\frac{92.3}{100} \times 13.5$ **or** (actual mass =) 0.923×13.5 = 12.5 (kg)	an answer 12.5 (kg) scores **2** marks allow 12 / 12.46 / 12.461 / 12.4605 (kg)	1 1	AO2 4.3.3.1
Total			**15**	

4.1.2.4 Group 0

Answer 25 · Mark scheme

June 2018 | 8462/1H | Original Q8



4.1.2.4 Group 0

Answer 26 · Mark scheme

June 2022 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • more vigorous bubbling (for rubidium) • bigger / brighter flame (for rubidium)	allow converse statements for potassium allow (rubidium) catches fire more quickly allow (rubidium) moves around more quickly allow (rubidium) explodes allow (rubidium) disappears more quickly allow (rubidium) melts more quickly	1	AO3 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		allow energy level for shell throughout allow converse argument in terms of potassium		AO1 4.1.2.5 4.4.1.2
	(rubidium's) outer shell / electron is further from the nucleus	allow the (rubidium) atom is larger allow (rubidium) has more shells	1	
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium)	allow (so) there is more shielding between the outer electron and the nucleus (in rubidium)	1	
	(so) the (outer) electron (in rubidium) is more easily lost	allow (so) less energy is needed to remove the (outer) electron (in rubidium)	1	

4.1.2.4 Group 0

Answer 26 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$	ignore state symbols allow multiples allow **1** mark for H_2 allow **1** mark for RbOH	3	AO2 4.1.1.1 4.1.2.5 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the noble gases have boiling points that increase going down the group		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(relative atomic mass =) $\frac{(90.48 \times 20)+(0.27 \times 21)+(9.25 \times 22)}{100}$ = 20.1877 = 20.2	allow (relative atomic mass =) $\frac{1809.6 + 5.67 + 203.5}{100}$ allow (relative atomic mass =) 18.096 + 0.0567 + 2.035 allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all of the values in **Table 1** ignore units	1 1 1	AO2 4.1.1.6

Total Question 5		11

4.1.2.4 Group 0

Answer 27 · 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

4.1.2.4 Group 0

Answer 27 · Mark scheme

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		

4.1.2.4 Group 0

Answer 27 · Mark scheme

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

4.1.2.4 Group 0

Answer 28 · Mark scheme

June 2024 | 8462/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(similarity) both have one outer (shell) electron	allow energy level for shell allow same number of outer (shell) electrons	1	AO1 4.1.2.1
	(difference) sodium has 3 shells but potassium has 4 shells	allow potassium has more shells allow (different) number of shells	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	any **two** from: • effervescence / bubbles / fizzing • (potassium) floats • (potassium) moves around • (potassium) becomes smaller • (potassium) melts • flame • explosion	ignore gas produced allow (potassium) forms a ball ignore colour of flame	2	AO1 4.1.2.5 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	blue / violet / purple		1	AO2
	(the solution is) alkaline	allow (the solution) contains OH^- (ions) allow (the solution) contains hydroxide ions allow the solution is basic	1	AO1 4.1.2.5 4.4.2.4

4.1.2.4 Group 0

Answer 28 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	all five points correctly plotted	allow a tolerance of ± ½ a small square allow **1** mark for three or four points correctly plotted	2	AO2 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	3.4 (mg/cm^3)	allow a value in the range 3.0 to 3.8 (mg/cm^3)	1	AO3 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	chlorine and potassium bromide		1	AO2 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	relative molecular mass increases and boiling point increases		1	AO1 4.1.2.6

Total Question 2	**11**

4.1.2.4 Group 0

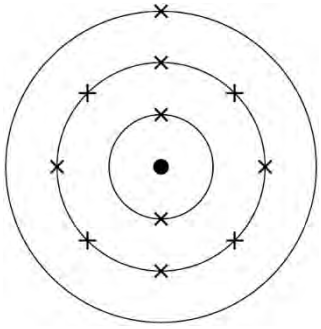
Answer 29 · Mark scheme

June 2025 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	towards the right **and** the top	allow a description of the position in the periodic table allow in Groups (3) 4 to 0	1	AO1 4.1.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	a melting point below 100 °C		1	AO3 4.1.2.3 4.2.2.7 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3		allow any combination of ×, ●, o, $e^{(-)}$ for electrons	1	AO1 4.1.1.7

4.1.2.4 Group 0

Answer 29 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	any **one** from: • so elements / tellurium / iodine were in groups with similar properties • iodine has similar properties to Group 7 elements • iodine has different properties to Group 6 elements	ignore reference to atomic structure allow named element(s) for Group 6 / 7 elements allow converse arguments in terms of tellurium	1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	argon has a full outer shell (of electrons)	allow energy level for shell allow argon has eight outer shell electrons ignore argon has no outer shell electrons	1	AO1 4.1.2.4
	(so argon) has a stable arrangement of electrons **or** (so argon) has a stable electronic structure	allow (so argon) does not gain / lose / share electrons	1	

4.1.2.4 Group 0

Answer 29 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	atoms with the same number of protons (but with) different numbers of neutrons	allow atoms of the same element allow atoms with the same atomic number ignore atoms with the same number of electrons	1 1	AO1 4.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	~115		1	AO2 4.1.1.6

Total Question 1	9

4.1.2.4 Group 0

Answer 30 · Mark scheme

June 2025 | 8462/1H | Original Q5

Question 5

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	any **two** from: • the mass of the atom is concentrated at the centre / nucleus • the nucleus is positive / charged • most of the atom is empty space • electrons orbit the nucleus	do **not** accept references to shells	2	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	electrons orbit the nucleus at specific distances	allow electrons orbit the nucleus in energy levels allow electrons orbit the nucleus in shells	1	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	~100 000 times larger		1	AO2 4.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(surface area = 6×1.2^2 =) 8.64 (nm^2)		1	AO2 4.2.4.1
	(volume = 1.2^3 =) 1.728 (nm^3)		1	
	(ratio = 8.64 : 1.728 =) $\frac{8.64}{1.728}$ (: 1)	allow (ratio = 1.728 : 8.64 =) (1 :) $\frac{1.728}{8.64}$ allow correct use of incorrectly determined values of surface area and / or volume	1	
	= 5 : 1	allow = 1 : 0.2	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6		allow converse arguments in terms of fine particles		AO3 4.2.4.2
	(nanoparticles) have a higher surface area to volume ratio		1	
	(so) less coating is used	(so) a thinner layer can be used	1	
	OR			
	(with nanoparticles) a thinner layer can be used (1)	allow less coating is used		
	(so) more light gets through the lenses (1)	allow (so) visibility is not reduced (as much)		

Total Question 5	12

4.1.2.4 Group 0

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1H Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.1.2.4 Group 0

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell, Director General.

4.1.2.4 Group 0

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.1.2.4 Group 0

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.1.2.4 Group 0

CHY1H Question 1

	answers	extra information	mark
(a)	any **two** from: • nitrogen • carbon dioxide • water (vapour) / steam	 accept formulae N / N_2 accept formula CO_2 ignore CO accept formula H_2O	2
(b)	any **three** from: <u>limestone</u> • abundant / local • natural material **or** no 'processing' needed • relatively easy to cut • appearance better <u>concrete</u> • <u>raw materials</u> are abundant • can be reinforced (by steel rods) / strong(er) / supported (by steel rods) • concrete mixture can be poured / moulded / constructed on site • less reactive with acid rain / weathering / erosion	no mark for 'limestone' or 'concrete' on first line – mark advantages only ignore ideas of speed of production or easier to use accept 'can build higher' ignore density / extraction / quarrying / pollution / cost	3
total			5

4.1.2.4 Group 0

CHY1H Question 2

	answers	extra information	mark
(a)(i)	$Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$	accept fractions and multiples	1
(ii)	any **two** from: • sulfur dioxide • causes acid rain • consequence of acid rain eg kills fish / plants	 accept sulphur dioxide / sulphur oxide / SO_2 ignore other comments eg global warming / ozone / global dimming / greenhouse effect	2
(b)	any **two** from: • heat (copper oxide with carbon) • oxygen is removed by carbon **or** carbon monoxide / carbon dioxide is produced **or** carbon displaces copper • because carbon is more reactive than copper	 accept copper (oxide) loses oxygen **or** carbon gains oxygen accept carbon oxide accept a correct word or balanced symbol equation allow a correct comparison of reactivity	2
(c)(i)	electrolysis	accept electroplating	1
(ii)	(electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys **or** named alloys		1

Continued on next page

4.1.2.4 Group 0

Question 2 continued

	answers	extra information	mark
(d)	any **three** explanations from: <u>for recycling</u> • less acid rain (pollution) • copper reserves last longer / conserved **or** do not run out • energy for extraction (saved) **or** less energy required • less mining / quarrying • less waste (copper) / electrical appliances dumped **or** less landfill <u>against recycling</u> • collection problems • transport problems • difficult to separate copper from appliances • energy used to melt the collected copper	ignore electrolysis / pollution ignore ideas about less machinery / plant ignore idea of cost	3
total			10

4.1.2.4 Group 0

CHY1H Question 3

	answers	extra information	mark
(a)(i)	core		1
(ii)	plate (boundaries)	accept parts of the crust ignore crust alone	1
	sudden movement / colliding **or** normally move a few centimetres per year	accept movement but ignore movement apart accept continental drift	1
	convection currents / driven by heat from radioactive processes / decay	idea of source of energy for the movement	1
	the idea of uncertainty with an explanation eg scientists do not know (with any certainty) • what happens under the crust • where the forces / pressure are building up • we cannot measure the forces • when the forces reach their limit	 ignore references to volcanoes	1
(b)(i)	78		1

Continued on next page

4.1.2.4 Group 0

Question 3 continued

	answers	extra information	mark
(ii)	marks awarded for any 2 gases from the following 3 gases	max **3** marks from CO_2	
	any **four** from: carbon dioxide has decreased: • used by plants / bacteria (stromatolites) • during photosynthesis (must be linked to CO_2 decrease) • 'locked up' in (sedimentary) rocks / carbonates / fossil fuels • dissolved in oceans **and / or** oxygen has increased because: • released by plants / bacteria (stromatolites) • during photosynthesis (must be linked to O_2 increase) **and / or** nitrogen has increased because • ammonia reacted with oxygen (to release nitrogen) • nitrogen is released by bacteria	ignore references to respiration	4
total			10

4.1.2.4 Group 0

CHY1H Question 4

	answers	extra information	mark
(a)	permitted additive / (added) chemicals **or** names / types of additives	accept the chemical name ignore food additive alone	1
(b)(i)	water and oil do not mix / are immiscible **or** don't dissolve each other	ignore density ignore emulsifier alone	1
(ii)	any **two** from: • emulsifier • forms an emulsion • holds the two components together • by lowering the surface tension	 accept description of an emulsion accept stops them separating / they mix allow bonds / binds for holds accept a description of how an emulsifier works for **two** marks eg 'tadpole' diagram or dispersal of oil drops	2
(c)(i)	(because they contain) a double (carbon carbon) bond	accept unsaturated ignore poly or mono	1
(ii)	results suggest sunflower oil is best **or** 'the one that took the least time' because (sunflower oil) has the highest amount of unsaturation / most double bonds / least saturated	 ignore uses up I_2 most quickly second mark is dependent on first	1 1

Continued on next page

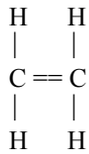
4.1.2.4 Group 0

Question 4 continued

	answers	extra information	mark
(d)(i)	any **one** from: • have a higher melting point than (vegetable) oil • are solid at (room temperature) / hardened / harder	 accept useful as spreads **or** doesn't soak into bread ignore hard / soft(er)	1
(ii)	any **two** from: • hydrogen added • to carbon carbon double bond / to saturate • (nickel) catalyst / temperature 60 - 150°C	 do **not** accept 'water' wrong catalyst doesn't get this mark ignore high / warm temperature	2
total			10

4.1.2.4 Group 0

CHY1H Question 5

	answers	extra information	mark
(a)(i)	by (fractional) distillation **or** fractionation	accept a description of the distillation process (heat and how separation works) eg heat **and** condense accept boil / vapourise etc for heat	1
(ii)	CO_2 H_2O	note the order of these products must be correct wrong way round = **1** mark	1 1
(b)(i)	(hexane) has been broken down (into smaller hydrocarbons / molecules)	accept (thermal) decomposition / cracked / split / broken up owtte	1
(ii)		accept $CH_2=CH_2$	1
(iii)	water / hydrogen oxide / steam	accept H_2O	1

Continued on next page

4.1.2.4 Group 0

Question 5 continued

	answers	extra information	mark
(c)	candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks. if they do not then the maximum mark is three any **four** from: <u>advantages of using sugar</u> • country has no wealth to buy (large quantities of) crude oil • country has limited technological development **or** underdeveloped / third world country • able / suitable climate to grow sugar cane • enough land to grow sugar cane / land cannot be used to grow food / deforestation • sugar is a renewable source **or** crude oil is a non-renewable resource / finite resource / limited resources • CO_2 / carbon neutral <u>advantages of using alkanes:</u> • economic costs are low • continuous process • country has large oil resources • country has oil refineries / cracking plants • very pure product • faster process	not 'expensive' alone	4
total			10

Answer 25 · Examiner comments

Question 8 (standard / high and high demand)

08.1 42% of students could answer this correctly. A hazard was asked for, and it was expected that students would use the correct chemical term for such a hazard; hence the idea that chlorine or carbon monoxide is **toxic** was required. Many did not use the correct term, referring instead to it being harmful (incorrect – it can kill, not merely make one ill), or dangerous or deadly (in what way?). Some students misread the equation and referred to carbon dioxide.

08.2 40**%** of students achieved the mark here. Many did not realise that their observations of a vigorous reaction with a small piece of sodium in the lab would be magnified enormously on an industrial scale. Hence the reaction would be **very** violent or explosive, not just vigorous.

08.3 There were many good attempts at this question, with 73% of students scoring at least one mark. Many students referred to the lack of reactivity of the metals with argon, but some forgot to refer to air. Then some students did not express themselves clearly, referring to one or both metals reacting with air in general, or even with gases not present in the air, such as hydrogen.

08.4 There were some excellent attempts at this difficult question, which discriminated well. 8% of students achieved full marks with 43% achieving at least one mark. Full credit could be gained by those who started with the premise that titanium chloride must be ionic so should have a high melting point; very few started from the true situation, which is that titanium chloride must exist as small molecules as its melting point is low.

The mark that was scored least often was for the explanation of the bonding and how it leads to the actual, or predicted, melting point. Some spoiled an otherwise good description of ionic bonding by also referring to ‘strong intermolecular forces’. Many referred to ‘strong electrostatic forces’ but failed to mention that those forces were between ions.

A significant number of students answered solely in terms of the separate elements, particularly titanium, rather than the compound.

08.5 51% of students achieved the mark for this question. Whilst the definition of oxidation in terms of electrons is well known, the question asked why **this** reaction is oxidation. So, it was necessary to refer to the sodium atoms losing electrons rather than giving a generalised answer. Some students referred to ‘it’ losing electrons, without specifying what ‘it’ referred to, while others referred to oxygen, which is not present.

08.6 54% of students achieved the mark here. It was not uncommon to see ‘$-e^-$’ on the right hand side. A significant number of incorrect responses showed the formation of a doubly charged sodium ion.

4.1.2.4 Group 0

08.7 This difficult unstructured calculation tested a new area of the specification, and discriminated very well. 74% of students were able to achieve at least one mark, usually for calculating the M_r of $TiCl_4$. 7% of students achieved all four marks, with 12% achieving at least three marks and there were some valiant efforts.

Common errors were:

- using 92 instead of 23 to calculate the number of moles of Na
- omitting the unit conversion from kg to g for the mole calculations
- using the 1:4 mole ratio incorrectly or not at all.

Also, it is not appropriate to leave answers in the form of a fraction, even if this is the default on their calculator. Answers should always be converted to decimal form.

08.8 This was well answered, with 74% of students achieving both marks. A few forgot the 100 in their expression and didn't realise they were making about 1000 kg more than the theoretical maximum.

4.1.2.4 Group 0

Answer 26 · Examiner comments

June 2022 | 8462/1H | Original Q5

Question 5 (Standard, standard/high and high demand)

05.1 Nearly half of students described how a specific observation would differ. Vague comments about a more violent reaction, with no specific visual observation, did not gain credit.

05.2 Most students scored at least two marks. They knew that rubidium would lose an electron more easily, and that it was the larger size of the atom that was responsible (often expressed as the rubidium atom having more shells). The description of the weaker attraction of the rubidium nucleus for the outer electron was less well expressed; some students omitted to say that the attraction was for the outer electron or that the attraction was between the outer electron and the nucleus. Some gave an inappropriate description of the attraction, such as intermolecular or magnetic. Some contradicted their attraction argument by saying that the outer electron in rubidium is less shielded from the nucleus, rather than more shielded.

05.3 Only about a sixth of students scored full marks. Many knew that one of the products was hydrogen, and could write its formula correctly. However, far fewer knew that RbOH was the other product. Of those who did, most managed to balance the equation correctly.

05.4 Fewer than half of students gave the correct answer. Nearly as many, though, stated that the noble gases all have eight outer shell electrons, appearing to forget about helium.

05.5 More than half of students completed the calculation successfully and rounded to the appropriate 3 significant figures. Common errors were to divide by 63 (sum of the mass numbers) or 3 (number of isotopes) rather than by 100.

4.1.2.4 Group 0

Answer 27 · 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.

4.1.2.4 Group 0

Answer 28 · Examiner comments — June 2024 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 This was very well answered by the majority of students, with nearly two thirds scoring both marks. Most stated that both atoms have one outer shell electron and that potassium has one more shell than sodium. Sometimes the wrong number of shells was given for the two elements; usually 2 shells for sodium and 3 for potassium. Some stated that potassium has more outer shells than sodium. This is not correct as the phrase 'outer shell' is always taken to mean the single outermost shell. Some students gave consequences of the electronic structure rather than referring to the electronic structure itself; this was not given credit. Simply stating that the number of electrons is different did not answer the question; the number of electrons is not the electronic configuration.

02.2 More than two thirds of students gave two correct observations, with bubbling and a flame being the most popular. 'Gas produced' did not gain credit as it is not an observation but a deduction from the observation of bubbling. 'Fizzing' is taken to mean effervescence, so fizzing and bubbling are the same thing rather than two different observations. Credit was not given for any observation requiring extra equipment such as a thermometer or an indicator.

02.3 Well over half of students gave a correct colour and a correct reason, either in terms of the solution being alkaline or containing hydroxide ions. Nearly three quarters of students gained one mark. Some students had evidently seen, and remembered, the experiment done with phenolphthalein in the water, and therefore stated the indicator colour to be pink even though they knew the solution to be alkaline. Some answers were not clearly expressed; 'potassium is an alkali' did not gain credit as it is the potassium hydroxide solution that is alkaline. There were

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Answer 28 · Examiner comments — June 2024 | 8462/1H | Original Q2

also, however, some excellent answers in terms of the hydroxide ion produced causing the solution to be alkaline.

02.4 More than four fifths of students plotted all of their points accurately. Many also drew a line of best fit although this was not required. A few drew their points as small dots instead of crosses, making it very difficult for the examiners to see them on a scanned image. Points do need to be visible, albeit sharp.

02.5 Students could nearly always estimate the density of krypton to within the tolerance allowed. Many used a line of best fit to do so although this was not necessary. In some cases inappropriate methods were used, such as finding the mean of all the other values; this did not gain credit even if it gave a value withing the range allowed.

02.6 Three quarters of students identified the correct pair of solutions, with the spread of incorrect responses being approximately equal.

02.7 Over two thirds of students identified the correct pair of trends. Most of the incorrect responses thought that boiling point decreases down the group.

4.1.2.4 Group 0

Answer 29 · Examiner comments

Question 1 (standard demand)

01.1 Only a quarter of students scored the mark, despite the clear statement in the specification. Many referred to the right of the table, but fewer referred to the top. Those who referred to specific groups were often correct but some omitted Group 0. Some referred to a 'staircase' but did not specify what it means; it should be noted that the periodic table provided does not show a staircase.

01.2 More than three quarters of students correctly chose the low melting point as the atypical property. The last distractor, 'forms positive ions' was the least popular, but the other distractors were about equal.

01.3 Nearly all students drew the electronic structure correctly. A few tried to use either 12 or 23 electrons.

01.4 Only two fifths of students were able to make sensible comments about the properties of the elements and either the groups that they would have been in or the groups that they were moved to. However, many comments were not clear, either not mentioning similar properties to the rest of the group or referring to vague regions of the periodic table rather than groups. Some stated that the elements were placed in order of atomic number, but atomic number was not known at Mendeleev's time, so these answers were disregarded. Some referred to leaving spaces for elements that had not been discovered, which does not answer this particular question.

01.5 Students scored well on this question, with more than two thirds scoring both marks and nearly all scoring at least one. Most referred to argon having a full outer shell of electrons, although some stated that there were no electrons in the outer shell, which is meaningless as the shell is not present without electrons. Fewer scored the second mark, for explaining that argon does not gain, lose or share electrons. Very few mentioned that the electron arrangement is stable; some said that argon is stable, which is just a rewording of the question.

01.6 The vast majority of students knew that isotopes have the same number of protons but a different number of neutrons. However, just over a half did not state that isotopes are atoms with the same number of protons, or atoms of the same element, so were restricted to one mark. Some implied that an isotope is a single atom where the number of neutrons is different to the number of protons, as in carbon-13.

01.7 The vast majority of students estimated the A_r correctly as ~115. The most popular distractor was ~114. Some students did not realise that an actual calculation was not required: only an estimation from the huge proportion of the isotope with mass number 115.

4.1.2.4 Group 0

Answer 30 · Examiner comments

June 2025 | 8462/1H | Original Q5

Question 5 (standard/high and high demand)

05.1 Over half of students scored both marks by giving the description in the specification. For the first marking point, the idea of both the shape and the charge were needed. Common errors were to refer to a positive 'cloud' or a ball of positive 'energy'. Other errors were to refer to protons, which had not been discovered, or to imply that there was an overall positive charge on the atom as a whole; atoms were known to be neutral in terms of charge. For the second marking point the electrons needed to be referred to as such, not just negative charge. Common errors were to imply that electrons were on the surface rather than embedded, or that they were moving.

05.2 This was well answered, with four fifths of students scoring at least one mark. Many referred to the mass being concentrated at the centre and also the positive charge but

4.1.2.4 Group 0

Answer 30 · Examiner comments

failed to refer to the centre as the nucleus. Many referred to most of the atom being empty space, but some simply said that there is empty space in the atom which is not quite the same. Fewer referred to electrons orbiting the nucleus, and many of those who did referred incorrectly to shells.

05.3 Whilst many students knew that Bohr's contribution to the model of the atom was electron shells, many did not mention that the electrons were orbiting the nucleus in these shells. Even fewer referred to specific distances from the nucleus. Many confused Bohr with Chadwick and stated that Bohr discovered neutrons. Only one third of students gave a fully correct answer.

05.4 More than four fifths of students gave the correct response, with 10 000 times larger being the most popular distractor.

05.5 Two thirds of students gave fully correct answers. Most students could calculate the volume correctly, although some incorrectly gave the units as nm instead of nm^3. They had more difficulty with the surface area, with some forgetting to multiply the area of one face by 6 and others miscounting the number of faces. The marks for calculating the ratio could be obtained from incorrect values for the surface area and / or volume. The simplest ratio was required, so this needed to be either a whole number ratio or with one of the values reduced to 1. Dividing one value by the other was by far the simplest way of finding the ratio. A few students unnecessarily decided to change the units from nm to m, mm or even μm. As this ratio is not dimensionless, this approach gave different values depending on the units chosen. Full marks could be obtained if the conversions were correct, but many were not. If students are not instructed to give an answer in particular units, they should stick with the ones provided.

05.6 Students found this question more difficult than expected, with fewer than half scoring one mark and about one in ten scoring both. Many students gave the general answer; that nanoparticles have a greater surface area to volume ratio. However, fewer were able to express clearly the idea that a thinner coating could be used, with many using ambiguous phrases such as 'less nanoparticles needed' rather than less of the coating or another description of less material in bulk. Fewer concentrated on the specific use in glasses. Although many said that visibility would not be reduced as much if nanoparticles were used, many thoughts this would be because the particles themselves could be seen if fine particles were used, which is not the case. Some students did not give answers in comparative terms, for example referring to a high (rather than higher) surface area to volume ratio.