AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.1.3

Ionic compounds

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**17**
Available paper years	**2009–2025**

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.

4.2.1.3 Ionic compounds

Answer 01 · Mark scheme

June 2009 | CHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	any **one** from: • they are positive / cations • they are H^+ • opposite charges attract	ignore atom	1
5(a)(ii)	potassium is more reactive (or reverse)	assume 'it' refers to hydrogen allow potassium reacts <u>with</u> water allow potassium is very reactive **or** most reactive metal / element allow hydrogen gains electrons more easily / is reduced more easily accept potassium is higher up the reactivity series	1
5(b)	6 **and** 2	accept correct multiples and fractions	1
5(c)(i)	the reaction / it is reversible **or** a description of a reversible reaction	allow 'it is an equilibrium' allow reversible symbol drawn correctly allow 'the reverse / back reaction'	1

Question 5 continues on the next page…

CHY2H

Question 5 Continued

question	answers	extra information	mark
5(c)(ii)	**lithium nitride** assume that 'it' or if they do not specify means lithium nitride assume lithium / lithium nitrate refers to lithium nitride • hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride plus **one** of: • does not explode / cause a fire • is not free / less hydrogen • is not under pressure • does not leak • is only released slowly • compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction	accept converse for hydrogen as below assume that gas / hydrogen means gas in the cylinder • hydrogen (in cylinder) / gas is not bonded / held / absorbed / in a compound / reacted with lithium nitride plus **one** of: • can explode / cause a fire • is free • is under pressure • can leak • releases quickly	1 1
5(d)(i)	smaller **or** correct indication of size **or** higher surface area	allow very / really small **or** tiny accept few (100) atoms in size allow 1 to 100 nanometres or 10^{-9} metres allow absorption and / or release of hydrogen more quickly allow have different properties allow 'more particles in each volume / area' do not allow reacts more quickly	1

Question 5 continues on the next page…

4.2.1.3 Ionic compounds

CHY2H

Question 5 Continued

question	answers	extra information	mark
5(d)(ii)	greater surface area		1
5(e)(i)	loss of an electron **or** loses electrons	do not accept any ref. to oxygen	1
5(e)(ii)	full outer shell of 8 electrons on circle	need not be paired can be ×, dot or e do **not** accept if extra electrons added to inner shell	1
Total			**10**

4.2.1.3 Ionic compounds

Answer 01 · Mark scheme

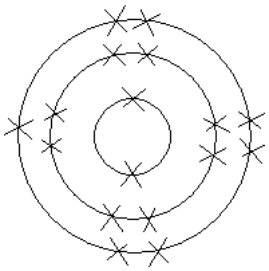
June 2009 | CHY2H | Original Q5 | Legacy

CHY2H

4.2.1.3 Ionic compounds

Answer 02 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)		accept dots / crosses / e must be drawn on diagram electrons do not need to be paired ignore brackets or + or −charges ignore 2,8,7	1
1(b)	(one) electron lost / given away / transferred from sodium / transferred to chlorine owtte	recognition that electrons are involved must be linked to electrons accept loses electron(s) for **2** marks NB loses 2 or more electrons gains **1** mark reference to sharing / covalent max **1** mark ignore charges on ions formed	1 1
1(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are attracted or it is oppositely charged ignore opposite forces attract	1
1(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 1 continues on next page

CHY2H

Question 1 continued

question	answers	extra information	mark
1(d)(i)	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging do **not** accept answers such as global warming / ozone layer etc. ignore safety unless qualified	1
1(d)(ii)	any **one** sensible idea eg • loss of work / unemployment **or** company goes out of business • any adverse effect on local economy (owtte) • any adverse effect on paper production / cost of paper / cost of water (treatment) • chlorine (compounds) have been used (for many years) without causing harm owtte • only a tiny amount of chlorine is released so it would not cause harm	eg shops / house prices etc. allow less expensive to use chlorine or converse ignore uses of chlorine to treat drinking water unless qualified	1
1(d)(iii)	ideas related to bias	accept more reliable or valid or fair ignore more accurate / fair test	1
Total			**8**

4.2.1.3 Ionic compounds

Answer 02 · Mark scheme

January 2010 | CHY2H | Original Q1 | Legacy

CHY2H

4.2.1.3 Ionic compounds

Answer 03 · Mark scheme

June 2010 | CHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	lead nitrate	accept $Pb(NO_3)_2$ do **not** accept nitride	1
	sodium iodide / potassium iodide	accept NaI / KI accept other correct soluble iodides do **not** accept sodium iodine / potassium iodine	1
5(a)(ii)	filter / filtration / filtering	accept decant / decanting etc. accept centrifugation ignore evaporation **or** heating if after filtration	1

Question 5 continues on the next page

Question 5 continued

question	answers	extra information	mark
5(b)	magnesium <u>loses</u> **<u>2</u>** <u>electrons</u>	metallic / sharing / covalent **or** molecule = max **3** all three underlined ideas must be present two underlined ideas = **1** mark eg magnesium loses electrons **or** magnesium gains 2 electrons **or** magnesium loses 2 ions nb magnesium **ion** loses 2 electrons = **1** mark 2 errors = **0** marks eg magnesium gains electrons	2
	<u>iodine</u> <u>gains</u> **<u>1</u>** / **<u>an</u>** <u>electron</u>	all four underlined ideas must be present three underlined ideas = **1** mark eg iodine gains electron(s) **or** iodine loses 1 / an electron **or** iodine gains 1 / an ion **or** iodide (ion) gains 1 / an electron 2 errors = **0** marks	2
5(c)	any **two** from: • forces *(*of attraction) / bonds are <u>strong</u> **or** lot of energy needed to break bonds • oppositely charged ions <u>attract</u> **or** electrostatic <u>attraction</u> between ions • <u>giant</u> structure **or** <u>lattice</u>	mention of molecules / intermolecular / covalent / atoms = max **1** allow many bonds ignore ionic bonding unqualified	2
Total			**9**

4.2.1.3 Ionic compounds

Answer 03 · Mark scheme

June 2010 | CHY2H | Original Q5 | Legacy

CHY 2H

4.2.1.3 Ionic compounds

Answer 04 · 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**

4.2.1.3 Ionic compounds

Answer 04 · Mark scheme

January 2011 | CHY1H | Original Q4 | Legacy

CHY1H

4.2.1.3 Ionic compounds

Answer 05 · Mark scheme

June 2011 | CHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	electron(s)	allow free / delocalised / negative electrons do **not** accept additional particles	1
5(a)(ii)	ion(s)	allow named ions from table ignore positive or negative do **not** accept additional particles	1
5(b)(i)	copper	accept Cu do **not** accept Cu^{2+}	1
5(b)(ii)	it is / they are positive (ions) and it is the least reactive	accept formula of positive ion	1 1
5(c)(i)	loss of electron(s)	ignore numbers	1
5(c)(ii)	$\mathbf{2H^+} + \mathbf{2e^-} \rightarrow H_2$	accept correct multiples / fractions accept e / e^- allow $\mathbf{2H^+} \rightarrow H_2 - \mathbf{2e^-}$	1
Total			**7**

4.2.1.3 Ionic compounds

Answer 05 · Mark scheme

June 2011 | CHY2H | Original Q5 | Legacy

CHY2H

4.2.1.3 Ionic compounds

Answer 06 · Mark scheme

Question 4

question	Answers	extra information	Mark
4(a)(i)	current / charge couldn't flow	allow could not conduct (electricity)	1
	because the ions / particles couldn't move **or** (salt) needs to be molten / dissolved (to conduct electricity) (1)	do **not** accept electrons/ molecules / atoms	1
	so that the ions / particles can move (1)	do **not** accept electrons / molecules / atoms	
4(a)(ii)	he had status **or** he had evidence / proof	accept he had authority **or** experience accept the experiment could be repeated	1
4(b)	hydrogen / H_2	do **not** allow hydrogen ions	1
	the ions are positive	accept because opposite (charges) attract	1
	potassium is more reactive (than hydrogen)	accept potassium ions are less easily discharged (than hydrogen) **or** potassium ions are less easily reduced (than hydrogen)	1
4(c)(i)	gain electron(s)	accept fully balanced correct equation for **2** marks	1
	one electron	if no other marks awarded allow (potassium ions) reduced for **1** mark	1
4(c)(ii)	$\mathbf{2}Cl^- \rightarrow Cl_2 + \mathbf{2e^-}$	must be completely correct, including charge on electron accept correct multiples	1
4(c)(iii)	2, 8, 8	accept any combination of dots, crosses, "e" or any other relevant symbol ignore any charges if given	1
Total			**10**

4.2.1.3 Ionic compounds

Answer 07 · Mark scheme

June 2014 | CH2HP | Original Q2 | Legacy

The full source mark scheme begins on page 40. Follow original question 2 in that document.

4.2.1.3 Ionic compounds

Answer 08 · Mark scheme

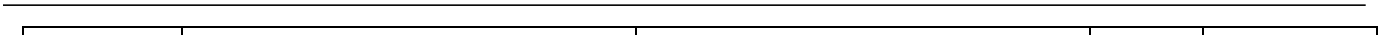
June 2015 | CH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	silver nitrate	allow $AgNO_3$	1	**AO3** 2.6.1d
5(a)(ii)	potassium carbonate **or** sodium carbonate	allow K_2CO_3 allow Na_2CO_3	1	**AO3** 2.6.1d
5(b)	base	allow ionic ignore insoluble or soluble ignore alkali	1	**AO1** 2.6.2a
5(c)(i)	evaporate **or** crystallise	allow heat or boil or leave (to evaporate) allow cool ignore filtration unless given as an alternative do **not** accept freeze or solidify	1	**AO1** 2.6.1c
5(c)(ii)	2 (HNO_3)	accept multiples	1	**AO2** 2.6.1b
5(c)(iii)	9	accept nine	1	**AO2** 2.6.1b 2.1.1a
5(d)	6.21/207 0.72/16 = 0.03 = 0.045 2 3 Pb_2O_3	**1** mark for dividing mass by A_r **1** mark for correct proportions (allow multiples) **1** mark for correct whole number ratio (allow multiples). Can be awarded from formula. allow O_3Pb_2 **ecf** allowed throughout if sensible attempt at step 1 correct formula with no working gains **1** mark	1 1 1 1	**AO2** 2.3.3b
Total			**10**	

4.2.1.3 Ionic compounds

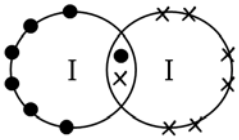
Answer 08 · Mark scheme

June 2015 | CH2HP | Original Q5 | Legacy



4.2.1.3 Ionic compounds

Answer 09 · Mark scheme June 2015 | CH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	lattice / giant structure	max **3** if incorrect structure or bonding or particles	1	**AO1** 2.1.1adef 2.2.2a
	ionic **or** (contains) ions		1	
	Na^+ **and** Cl^-	accept in words or dot and cross diagram: must include type and magnitude of charge for each ion	1	
	electrostatic attraction	allow attraction between opposite charges	1	
6(b)	hydrogen	allow H_2	1	**AO1** 2.7.1i
	sodium hydroxide	allow NaOH	1	
6(c)	any **one** from, eg: • people should have the right to choose • insufficient evidence of effect on individuals • individuals may need different amounts	allow too much could be harmful ignore religious reasons ignore cost ignore reference to allergies	1	**AO3** 2.1
6(d)(i)	one bonding pair of electrons 6 unbonded electrons on each atom	accept dot, cross or e or – or any combination, eg 	1 1	**AO2** 2.1.1b,g

Question 6 continues on the next page

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(d)(ii)		max **2** if incorrect structure or bonding or particles		**AO1/ AO2** 2.2.1ab
	simple molecules	accept small molecules accept simple / small molecular structure	1	
	with intermolecular forces	accept forces between molecules must be no contradictory particles	1	
	which are weak **or** which require little energy to overcome – must be linked to second marking point	reference to weak covalent bonds negates second and third marking points	1	
6(d)(iii)	iodine has no delocalised / free / mobile electrons or ions		1	**AO1** 2.2.1c
	so cannot carry charge	if no mark awarded iodine molecules have no charge gains **1** mark	1	2.1.1g
Total			**14**	

4.2.1.3 Ionic compounds

Answer 10 · Mark scheme

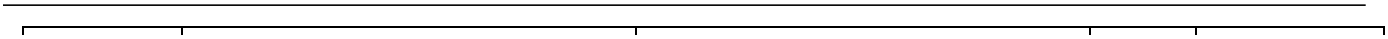
June 2015 | CH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	increase		1	**AO1** 3.1.3.f
3(b)(i)	Na^+ **and** Br^-	both required	1	**AO1** 3.1.3.a/e
3(b)(ii)	sodium chloride	allow NaCl do **not** allow sodium chlorine	1	**AO2** 3.1.3.g
3(b)(iii)	chlorine is more reactive than bromine	allow converse argument allow symbols Cl, Cl_2, Br and Br_2 allow chlorine / it is more reactive. do **not** allow chloride **or** bromide	1	**AO1** 3.1.3.g
3(b)(iv)	fluorine	allow F / F_2. do **not** allow fluoride.	1	**AO2** 3.1.3.g
Total			**5**	

4.2.1.3 Ionic compounds

Answer 10 · Mark scheme

June 2015 | CH3HP | Original Q3 | Legacy



4.2.1.3 Ionic compounds

Answer 11 · 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

4.2.1.3 Ionic compounds

Answer 11 · Mark scheme

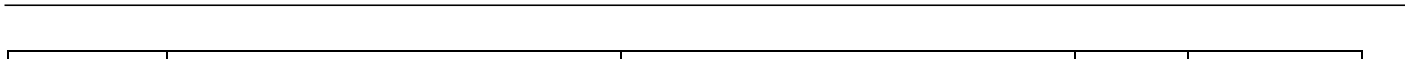
June 2018 | 8462/1H | Original Q2

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**	

4.2.1.3 Ionic compounds

Answer 11 · Mark scheme

June 2018 | 8462/1H | Original Q2



4.2.1.3 Ionic compounds

Answer 12 · Mark scheme

November 2020 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	poly(ethene) water		1 1	AO2 4.2.1.4 4.2.2.4 4.2.2.5

Question 1 continued

Question	Answers	Mark	AO/ Spec. Ref
01.2	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO1 4.2.1.2 4.2.1.3 4.2.1.4
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content • (both) carbon dioxide and silicon dioxide are made up of atoms • (but) magnesium oxide is made up of ions • (both) silicon dioxide and magnesium oxide are giant structures • (but) carbon dioxide is small molecules • with weak intermolecular forces • all three compounds have strong bonds • (both) carbon dioxide and silicon dioxide are formed from two non-metals • (so) bonds formed are covalent • (so) electron (pairs) are shared (between atoms) • (but) magnesium oxide is formed from a metal and a non-metal • (so) bonds in magnesium oxide are ionic • (so) electrons are transferred • from magnesium to oxygen • two electrons are transferred • bonds in silicon dioxide are single bonds • (where) each silicon forms four bonds • (and) each oxygen forms two bonds • (but) in carbon dioxide the bonds are double bonds • (where) carbon forms two double bonds • (and) oxygen forms one double bond ignore properties e.g. melting point, electrical conductivity		

Total			8

4.2.1.3 Ionic compounds

Answer 13 · Mark scheme

November 2021 | 8462/1H | Original Q4

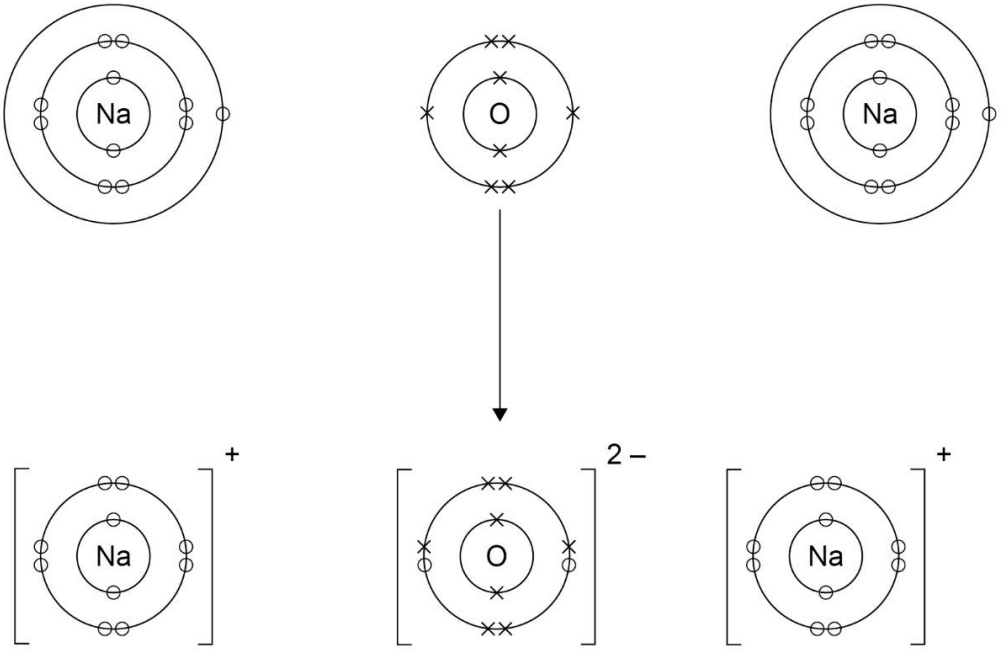
Question 4

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**

4.2.1.3 Ionic compounds

Answer 14 · Mark scheme

June 2024 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	each calcium atom loses two electrons	allow **1** mark for calcium atoms lose electrons **and** chlorine atoms gain electrons	1	AO2 4.2.1.2
	(and) each chlorine atom gains one electron		1	
	(so) one calcium atom reacts with two chlorine atoms		1	
	(to form) Ca^{2+} ions **and** Cl^- ions **or** (to form) calcium ion(s) **and** chloride ion(s)	allow (to form) ions with full outer shells allow energy level for shell	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the ions cannot move	allow the ions are in fixed positions	1	AO1 4.2.2.3 4.4.3.1 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	hydrogen	allow H_2	1	AO2 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$2Cl^- \rightarrow Cl_2 + 2e^-$		1	AO2 4.1.1.1 4.4.3.4 4.4.3.5 RPA3

4.2.1.3 Ionic compounds

Answer 14 · Mark scheme

June 2024 | 8462/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5		allow cathode for negative electrode allow anode for positive electrode allow attraction for movement		AO3 4.4.3.1
	Cu^{2+} / copper ions are blue **and** CrO_4^{2-} / chromate ions are yellow		1	
	(because) Cu^{2+} / copper ions move to the negative electrode		1	
	(and also) CrO_4^{2-} / chromate ions move to the positive electrode		1	

Total Question 5	10

4.2.1.3 Ionic compounds

Answer 15 · Mark scheme

June 2025 | 8462/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	CaS		1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	calcium (atom) loses electrons		1	AO2 4.2.1.1 4.2.1.2
	sulfur (atom) gains electrons		1	
	reference to transfer of two electrons		1	
	calcium forms positive ions **and** sulfur forms negative ions	allow Ca^{2+} (ions) **and** S^{2-} (ions) are formed allow calcium ions **and** sulfide ions are formed	1	

4.2.1.3 Ionic compounds

Answer 15 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.2.1.1 4.2.1.4 4.2.2.6 4.2.3.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • giant structure • layers • of hexagonal rings • each (carbon) atom forms three bonds • has no covalent bonds between layers • with delocalised electrons • one delocalised electron from each carbon atom • the bonds are covalent • with shared (pairs of) electrons • the (covalent) bonds are strong		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	the molecules do not have an (overall electric) charge	allow there are no ions allow there are no delocalised electrons	1	AO1 4.2.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	poly(ethene) has stronger intermolecular forces to overcome than methane		1	AO1 4.2.2.4 4.2.2.5

Total Question 2	11

4.2.1.3 Ionic compounds

Answer 16 · Mark scheme

June 2025 | 8462/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	strong electrostatic forces	allow strong forces of attraction ignore strong ionic bonds	1	AO1 4.2.1.3 4.2.2.3
	between oppositely charged ions	allow between (positive) aluminium ions and (negative) oxide ions allow between Al^{3+} (ions) and O^{2-} (ions)	1	
	(which) act in all directions (in the giant structure)		1	
	(so) need a lot of energy to break (the many strong bonds)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	cryolite	allow Na_3AlF_6	1	AO1 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	the mixture has a lower melting point than aluminium oxide	allow to lower the melting point (of the mixture) allow to lower the energy demand (of the process)	1	AO1 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$2\,O^{2-} \rightarrow O_2 + 4\,e^-$	allow multiples allow **1** mark for $O^{2-} \rightarrow O_2 + e^-$ with no / incorrect balancing numbers	2	AO2 4.1.1.1 4.4.3.2 4.4.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the (positive) electrode is made of carbon / graphite		1	AO1 4.4.3.3
	(so) the carbon / graphite reacts with oxygen (produced in the electrolysis)		1	
	(which) produces carbon dioxide		1	

Total Question 6	**11**

4.2.1.3 Ionic compounds

Answer 17 · Mark scheme

June 2025 | 8462/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	calcium (ions) **or** magnesium (ions)	allow Ca^{2+} (ion) allow Mg^{2+} (ion) allow zinc / Zn^{2+} (ion)	1	AO1 4.8.3.2 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(test) add excess sodium hydroxide (solution) (result) with sodium hydroxide the (white) precipitate dissolves	 allow with sodium hydroxide a colourless solution is produced	1 1	AO1 4.8.3.2 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	Ca^{2+}	ignore calcium	1	AO1 4.2.1.2 4.8.3.1 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	Cl^-	ignore chloride	1	AO1 4.2.1.2 4.8.3.4 RPA7

4.2.1.3 Ionic compounds

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(test) (bubble the gas through) limewater	allow (bubble the gas through) calcium hydroxide solution	1	AO1 4.8.2.3 4.8.3.3 RPA7
	(result) (which) turns milky / cloudy	MP2 is dependent upon MP1 being awarded	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6		allow converse argument		
	(using ethanoic acid) the rate of reaction is lower		1	
	(because) ethanoic acid is a weak(er) acid		1	
	(so) the concentration of hydrogen ions is lower	allow (so) ethanoic acid is (only) partially ionised	1	
	(and) the frequency of collisions is lower		1	

Total Question 6	11

4.2.1.3 Ionic compounds

GCSE

ADDITIONAL SCIENCE / CHEMISTRY

CH2HP
Mark scheme

4408 / 4402
June 2014

Version: 1.0 Final

4.2.1.3 Ionic compounds

PMT

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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 from aqa.org.uk

Copyright © 2014 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

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 Assessment Objectives and specification content that each question is intended to cover.

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 and underlining

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 bullet points 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.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students 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.

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

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

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

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student 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, 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 or by each stage of a longer calculation.

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 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding (for a C grade), supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.2.1.3 Ionic compounds

MARK SCHEME – GCSE ADDITIONAL SCIENCE / CHEMISTRY – CH2HP – JUNE 2014

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(a)(i)	(phosphoric) acid	*allow phosphoric*	1	2 / 2.6.2d	G
1(a)(ii)	H^+ / hydrogen (ion)	*if ion symbol given, charge must be correct*	1	2 / 2.6.2d	E
1(b)(i)	pencil so it will not run / smudge / *dissolve* **or** because ink would run / smudge / *dissolve*	 *ignore pencil will not interfere with / affect the results* *ignore ink will interfere with / affect the results*	1 1	2 / 2.3.2b	E
1(b)(ii)	any **three** from: • *3* colours in Cola • *2* colours in Fruit drink • one of the colours is the same • two of the colours in Cola are different • one of the colours in Fruit drink is different • *one of the colours in Cola is the most soluble*	*reference to spots / dots = max **2*** *allow colouring for colour* *allow more colours in cola **or** fewer colours in fruit drink* *allow some of the colours in the drinks are different* *accept one of the colours in Cola has the highest R_f value*	3	3 / 2.3.2b	E
1(c)	different substances travel at different speeds **or** have different retention times	*accept different attraction to solid* *ignore properties of compounds*	1	1 / 2.3.2c	E

4.2.1.3 Ionic compounds

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(d)(i)	Is there caffeine in a certain brand of drink?		1	3 / 2.3.2	A
1(d)(ii)	any **two** from: • cannot be done by experiment • based on opinion / *lifestyle choice* • ethical, *social* or economic issue	*accept caffeine has different effects on different people*	2	3 / 2.3.2	E
Total			**11**		

4.2.1.3 Ionic compounds

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td colspan="4">2 Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a ‘best-fit’ approach to the marking.
<table>
<tr><th>0 marks</th><th>Level 1 (1–2 marks)</th><th>Level 2 (3–4 marks)</th><th>Level 3 (5–6 marks)</th></tr>
<tr><td>No relevant content</td><td>There is a statement about the bonding and/or structure or melting / boiling point of chlorine or sodium chloride.</td><td>There are statements about the bonding and/or structure of chlorine or sodium chloride.</td><td>There are statements about the bonding and/or structure of chlorine and sodium chloride.

There is an explanation of why chlorine is a gas or sodium chloride is a solid.</td></tr>
</table>
Examples of chemistry points made in response:
Chlorine:
covalent bonds between atoms
forming simple molecules
no / weak attraction / bonds between molecules
low boiling point

Sodium chloride:
ionic bonds or electrostatic attraction
strong bonds
in all directions
between oppositely charged ions
forming giant lattice
large amounts of energy needed to break bonds
high melting point</td><td>1 + 2 / 2.1.1f/g 2.2.1a 2.2.2a</td><td>E</td></tr>
<tr><td>Total</td><td></td><td></td><td>6</td><td></td><td></td></tr>
</table>

4.2.1.3 Ionic compounds

MARK SCHEME – GCSE ADDITIONAL SCIENCE / CHEMISTRY – CH2HP – JUNE 2014

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
3(a)	O_2 in correct space		1	2 / 2.4	E
	correct balancing	accept multiples	1		
3(b)(i)		*incorrect reference to energy = max **2***		1 / 2.4.1d	E
		ignore references to equilibrium			
	rate increases		1		
	because particles are closer together	accept because there are more particles (per unit volume)	1		
		allow particles have less space / room to move around			
	so frequency of collisions increases	*accept particles are more likely to collide*	1		
		ignore more collisions			
		ignore more successful collisions			
3(b)(ii)	has a greater surface area		1	3 / 2.4.1f/g	E
	so the reaction is faster	*accept so more frequent collisions*	1		
3(c)	the (minimum) amount of energy (particles must have) to react ***or*** *to start a reaction*	accept the energy needed to break bonds	1	1 / 2.4.1b	E
		ignore references to heat			
3(d)(i)	(potassium is) too / *very* reactive	*ignore potassium is a Group 1 / alkali metal*	1	1 + 2 / 2.6.1b	E
	so dangerous / *violent reaction*	accept hydrogen produced rapidly	1		
3(d)(ii)		accept products in either order		2 / 2.6.2b	E
		ignore names of substances			
		*do **not** accept brackets or charges in the formulae*			
	$ZnSO_4$		1		
	H_2		1		

3(d)(iii)	any **one** from: • increase concentration (of sulfuric acid) • increase temperature **or** heat it • increase surface area of zinc		1	1 / 2.4.1	E
Total			**13**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(a)(i)	so ions can move (and carry charge)	accept so current can flow *allow so it can conduct (electricity)* *allow so charged particles can move* *do **not** accept so electrons can move*	1	1 / 2.7.1a/b	E
4(a)(ii)	because zinc ions gain electrons 2 (electrons) zinc is formed	accept because zinc ions are reduced *accept correct half equation for **3** marks* *if no mark gained allow* *positive ions go to negative electrode **or*** *opposites attract **or*** *reduction (of zinc) **or*** *(zinc) gains electrons for **1** mark*	1 1 1	1 + 2 / 2.7.1b/c/e	E
4(a)(iii)	**2** Cl^- ⟶ Cl_2 + **2** e^-	must be completely correct	1	1 / 2.7.1g	E
4(b)(i)	because the magnesium is *a gas*	*allow magnesium goes from solid to gas*	1	2 / 2.6.1a	E
4(b)(ii)	(a reaction which) takes in energy (from the surroundings)	*accept more energy needed to break bonds than released by forming bonds* *accept correct reference to energy level diagram* *allow (a reaction which) takes in heat (from the surroundings)*	1	1 / 2.5.1a/b	E

4.2.1.3 Ionic compounds

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(b)(iii)	(M_r MgO =) 40	*accept* ($2\ M_r$ MgO =) 80	1	2 / 2.3.3c	E
	1.2/24 (x40) **or** 0.05 (x40) **or** 40/24 (x1.2) **or** 1.67 (x1.2)	allow ecf from step 1	1		
	2(.0)	allow ecf carried through from step 1 correct answer with or without working gains **3** marks	1		
4(b)(iv)	75(%)		1	2 / 2.3.3e	E
4(b)(v)	any **one** from: • the reaction is reversible • *some lost /escaped/ released (when* separated) • some of the reactant may react in different ways from the expected reaction • *impure reactant(s)*	*accept incomplete reaction* *ignore equilibrium not reached* *ignore measurement and calculation errors*	1	1 / 2.3.3d/f	E
Total			**12**		

4.2.1.3 Ionic compounds

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)	nanotubes can slide (over each other) because no (covalent) bonds between the nanotubes	allow nanotubes can roll (over each other) *accept weak forces between the nanotubes **or** weak intermolecular forces* *allow layers for nanotubes throughout*	1 1	1 / 2.2.3d	E
5(b)	delocalised electrons *so (delocalised) electrons* can move through the graphite	*accept free electrons* *accept so (delocalised) electrons can carry charge through the graphite*	1 1	1 + 2 / 2.2.3c/e	E
Total			**4**		

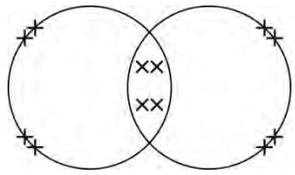
4.2.1.3 Ionic compounds

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
6(a)(i)	any **two** from: • *100% of (type 1 and type 2) bacteria are killed with a particle size of 7.5 to 8.5 nm* • *as the size increases (beyond 8.5 nm), nanoparticles are less effective at killing (type 1 and type 2) bacteria* • *type 1 shows a linear relationship **or** type 2 is non-linear* • type 1 bacteria more susceptible than type 2 (at all sizes of nanoparticles shown on the graph)	*ignore any conclusion drawn referring to data below 7.5 nm or above 20 nm* *accept nanoparticles in the range of 7.5 to 8.5 nm are most effective at killing (type 1 and type 2) bacteria* *allow type 2 bacteria are harder to kill*	2	3 / 2.2.6a	E
6(a)(ii)	(yes) because you *could confirm the pattern that has been observed* **or** (no) because trend/*conclusion* is already clear	*allow would reduce the effect of anomalous points / random errors* *allow would give better line of best fit* *ignore references to reliability / precision / accuracy / reproducibility / repeatability / validity*	1	3 / 2.2.6a	E

6(b)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **3**		1 / 2.1.1c/f	E
	magnesium loses electron(s)		1		
	oxygen gains electron(s)		1		
	<u>two</u> electrons (per atom)		1		
	gives full outer shells (of electrons) ***or*** *eight electrons in highest energy level*	*accept noble gas structure*	1		
	or				
	(electrostatic) attraction between ions **or** forms ionic bonds				

Total			**7**

4.2.1.3 Ionic compounds

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7(a)	*weaker bonds* ***or*** *fewer bonds* ***or*** *disruption to lattice*	*allow (other substances) react with the silicon dioxide* *ignore weaker / fewer forces* *do **not** accept reference to intermolecular forces / bonds*	1	2 / 2.2.3a	E
7(b)(i)	Na_2O	*do **not** accept brackets or charges in the formula*	1	2 / 2.1	E
7(b)(ii)	 2 bonding pairs 2 lone pairs on each oxygen	*electrons can be shown as dots, crosses, e or any combination* *accept 4 electrons within the overlap* *accept 4 non-bonding electrons on each oxygen*	 1 1	1 / 2.1	E
7(c)	 *lattice / regular pattern / layers / giant structure / close-packed arrangement* (of) positive ions **or** (of) atoms (with) delocalised / free electrons	reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**	 1 1 1	1 / 2.1.1h/i	E
Total			**7**		

4.2.1.3 Ionic compounds

Answer 11 · 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 11 · 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.

4.2.1.3 Ionic compounds

Answer 12 · Examiner comments November 2020 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 Few students scored both marks. Diamond and sodium chloride were both commonly seen incorrect responses.

01.2 Many students were unable to reach the higher marks because they did not make direct comparisons. Instead, they gave separate descriptions of the three compounds. Many also referred to the properties of the compounds, which were not required. The phrase 'intermolecular forces' was used indiscriminately to describe interactions between ions or in giant covalent structures, as well as between molecules.

Answer 13 · 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.

4.2.1.3 Ionic compounds

Answer 14 · Examiner comments

June 2024 | 8462/1H | Original Q5

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

05.1 This question required the use of precise scientific language in responses, which was a major difficulty for many students. Only one in eight students scored all four marks, with more than a third not scoring at all. Although the question asked students to describe what happens to atoms of calcium and chlorine, many failed to include the word 'atoms' when referring to calcium and chlorine. 'Calcium' and 'chlorine' refer to the elements in bulk, not to individual atoms. Similarly, the ions formed were often not referred to as ions either by name (chloride, not 'chlorine' ions) or by formula. It is the resulting ions which have complete outer shells, not atoms. Some students did not read the question properly and described the electrolysis of calcium chloride rather than its formation. Some students described the transfer of electrons from calcium atoms to chlorine atoms correctly, but then referred to the atoms 'sharing' electrons.

05.2 Only two fifths of students could give a correct answer in terms of the lack of mobility of the ions. Many students referred to the inability of electrons to move rather than ions. Some said that substances have to be molten or in aqueous solution to be electrolysed but did not say why that was the case.

05.3 Fewer than half of the students knew that hydrogen was the product. Calcium was the most popular incorrect response, with chlorine and hydrogen ions also being named as the product.

05.4 Two thirds of students identified the correct half equation, with the most popular distractor being the reverse half equation, with chlorine as a reactant rather than the product.

05.5 Over half of students recognised that the Cu^{2+} ions were moving towards the negative electrode, and that the CrO_4^{2-} ions were moving towards the positive electrode. However, less than a third deduced that Cu^{2+} ions are blue and CrO_4^{2-} ions are yellow, with many referring to the 'formation' of those colours rather than their separation. Some tried to refer to electrode processes, even though the diagram shows that the ions in question have not yet reached the electrodes. Many failed to refer to ions at all, referring instead to 'copper' and 'chromium oxide;' these gained no credit. Some students seem to believe that copper is blue (rather than copper ions).

Answer 15 · Examiner comments

June 2025 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 Fewer than half of students could count the ions and realise that the ratio was 1:1 so the formula is CaS. Some tried to do it from the formulae of the ions but often wrote $CaSO_4$. Ca_9S_9 was a common incorrect answer, as was 9CaS. A formula was required, not an equation; equations did not gain credit.

02.2 More than three fifths of students gave fully correct answers, and nearly all scored at least 3 marks. The main omission was not saying what ions were formed. Students sometimes contradicted themselves by describing the atoms sharing electrons as well as those electrons being transferred. Any mention of sharing electrons negated the first three marking points. The correct formula of the sulfide ion was sometimes contradicted by an incorrect name such as 'sulfur ion' or 'sulfate ion'.

02.3 This was well answered by the majority of students, with two thirds reaching level 2. The question discriminated well. Many referred to the giant structure, the layers, the covalent bonds and the delocalised electrons. Fewer referred to the hexagonal rings of carbon atoms, with some incorrectly referring to the layers themselves as hexagonal. Many tried to refer to each carbon atom having three bonds, but some could not express themselves clearly, for example by leaving out the word atom or by implying that the whole structure contained only 3 bonds or 3 atoms. Fewer referred to the strength of the covalent bonds, with some incorrectly saying that covalent bonds are weak. Many also referred to the lack of covalent bonds between layers or the presence of weak intermolecular forces between the layers, but some referred to intermolecular forces without specifying their location. Very few referred to covalent bonds being shared pairs of electrons or to the fact that there is one delocalised electron per carbon atom. Many students introduced properties of graphite, which were not asked for and did not gain credit.

02.4 Very few gave the expected answer, which is the syllabus statement that small molecules do not have an overall electric charge. Some did try to refer to this but were not clear enough; 'they do not have an overall charge' does not necessarily refer to the small molecules since the subject of the sentence was 'substances. More than half did score the mark, but this was usually due to a reference to the lack of delocalised electrons. Some stated that there was no space for delocalised electrons, which is not the same thing and did not gain credit. Some stated that there are no mobile ions, which is ambiguous as it could mean that there are ions, but they are not mobile; this would not be correct.

02.5 Just over a half of students gave the correct reason, with 'poly(ethene) has more covalent bonds to break than methane' being the most popular distractor. Some ticked 2 boxes – usually the first and last; this automatically scores zero when the instruction is to tick **one** box.

4.2.1.3 Ionic compounds

Answer 16 · Examiner comments

June 2025 | 8462/1H | Original Q6

Question 6 (standard, standard/high and high demand)

06.1 This was a high demand question which required the use of correct terminology. The question discriminated well, with three fifths of students gaining one mark but very few scoring all four. Many students referred correctly to strong electrostatic forces of attraction and to the large amount of energy needed to break these. Fewer referred correctly to the particles that those forces acted between, i.e. the oppositely charged ions; some referred incorrectly to the forces being between bonds. Some referred to

Answer 16 · Examiner comments June 2025 | 8462/1H | Original Q6

'oxygen ions' rather than oxide ions. There were very few who stated that the electrostatic forces act in all directions in the giant structure, despite the statement in the specification; this was the mark that most students did not score. Some students ruined their answer by the use of the word 'intermolecular', which is not appropriate as there are no molecules. Most students did recognise that a lot of energy was needed to break bonds but had contradicted this marking point earlier in their response by referring to the bonds as intermolecular forces. Some referred to 'more' energy being needed to break the bonds; this did not gain credit because the question did not require a comparison to anything else, and 'more' does not necessarily imply 'a lot'.

06.2 Only a half of students knew that cryolite was the correct substance. The most common incorrect answer was water.

06.3 Only one in five students scored the mark. Many students missed the point and referred to allowing ions to flow. The idea that the mixture has a lower melting point than pure aluminium oxide so that less energy is required was not well known. It is not correct to say that the melting point of aluminium oxide is lowered, as aluminium oxide has a fixed melting point. Some appear to think incorrectly that cryolite is a catalyst.

06.4 Students had difficulty with this high demand question, but it did discriminate well between the higher achieving students. One in five students scored both marks. Many could not write the formula of the oxide ion, and of those who could, some had the oxygen on the left and the oxide ion on the right. Those who could write the correct formulae could often balance the equation correctly, with the correct number of electrons on the right. An electron must be written with its charge in an ionic equation, as e^-, so that the charge balances as well as the atoms.

06.5 This question discriminated well, with half of students scoring at least one mark and more than a third scoring all three. Those who knew that the positive electrode is made of carbon often went on to score all three marks, although some merely referred to oxidation of the electrode rather than a specific reaction with the oxygen produced. There appeared to be much guesswork, with unspecified corrosion of an electrode made of an unspecified material being fairly common. Some thought that the deterioration of the electrode was due to its gaining electrons, and some thought that the electrode was made of iron and would rust.

Answer 17 · Examiner comments

Question 6

06.1 Three quarters of students correctly identified either calcium or magnesium. A few students gained credit for zinc.

06.2 Just over a quarter of students scored both marks on this item. Many students repeated the information given to them in the stem of the question, stating that they would add sodium hydroxide and observe a white precipitate, which did not gain marks. Some described adding more sodium hydroxide, without specifying that this should be until excess and whilst these students were not awarded the first marking point, they still had access to the second marking point.
Descriptions of the result were often vague. Some responses stated that 'the precipitate would dissolve' but failed to identify the reagent. Others simply said, 'it' will redissolve, become clear, or turn colourless, which was insufficient. There was a misconception that the aluminium dissolves, rather than the precipitate.

06.3 Both the correct symbol and the charge on the ion were required to gain the mark for this item. A quarter of students did this. Many others wrote the name, or the symbol without a charge.

06.4 As with 06.3, both the symbol and the charge on the ion were needed to gain the mark. As with 06.3, a quarter of students answered this correctly. Similar mistakes, writing the name or a symbol without a charge were commonly seen.

06.5 Around two thirds of students gained both marks on this item. A small number of students described adding limewater to solution C, rather than bubbling the gas produced through limewater.

06.6 Around half of students identified ethanoic acid as a weak acid and stated that the rate of reaction was lower. Fewer students were able to describe a lower concentration of hydrogen ions, with some describing fewer hydrogen ions without making any reference to volume. Credit was given to those who described ethanoic acid as partially ionised, however, there was the misconception that less hydrogen ions were ionised. Only a minority of students made a correct reference to the frequency of collisions.