PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



MARK SCHEME

TOPIC 1: KEY CONCEPTS IN CHEMISTRY: IONIC BONDING (PAPER 1)

SCORE	PERCENTAGE
/150	%

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • reduction and oxidation occurring (1) • {Zinc (atoms)/ Zn} lose electrons **and** are oxidised (1) • {Cadmium **ions**/ Cd^{2+}} gain electrons **and** are reduced (1)	ignore numbers of electrons correct or otherwise MP1 scores even if wrong (or no) species identified reject zinc ions reject cadmium (atoms) gains electrons allow half-equations for gain/loss of electrons part of answer For MP2 and MP3 if both marks not scored: {Zinc (atoms)/ Zn} lose electrons **and** {Cadmium **ions**/ Cd^{2+}} gain electrons (1) **OR** {Zinc (atoms)/ Zn} are oxidised **and** {Cadmium **ions**/ Cd^{2+}} are reduced (1)	**(3)** AO1-1

Question number	Answer	Mark
(ii)	**C** $Cd_3(PO_4)_2$ is the only correct answer **A**, **B** and **D** are incorrect formulae of cadmium phosphate	**(1)** AO1-1

(**QU03b 1SC0/1CH, June 2024**)

Q2.

Question number	Answer	Mark
(i)	**B** 2.8 is the only correct answer **A** is incorrect as there are too few electrons **C** and **D** are incorrect as there are too many electrons	**(1)** **AO** **1-1**

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking SOLID • is an (ionic) lattice / (ions are) held by strong (electrostatic) attractions (1) • so the **ions** {cannot move / are fixed / just vibrate} (1) SOLUTION • in solution the **ions** {can move / are free} (1)	allow giant structure / regular arrangement / regular structure for lattice allow atoms / (charged) particles in MP1 only ignore electrons for MP1 reject molecules / elements reject electrons allow liquid for solution reject electrons reject intermolecular forces	**(3)** **AO** **2-1**

(**Q06a 1SC0/1CF, June 2024**)

Q3.

Question number	Answer	Mark
(i)	**B** 2.8 **A** is incorrect as there are too few electrons **C** and **D** are incorrect as there are too many electrons	**(1) AO1-1**

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking SOLID • has an {(ionic) lattice / ions held by strong (electrostatic) attractions} (1) • so the **ions** {cannot move / are fixed / just vibrate} (1) SOLUTION • in solution the **ions** {can move / are free} (1)	allow giant structure / regular arrangement / regular structure for lattice allow atoms / (charged) particles in MP1 only ignore electrons for MP1 reject molecules / elements reject electrons allow liquid for solution reject electrons reject intermolecular forces	**(3) AO2-1**

(**QU02a 1SC0/1CH, June 2024**)

Q4.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • gain of electron(s) (1) • one electron (1)	MP2 depends on MP1 gains an electron (2)	**(2) AO 1-1**

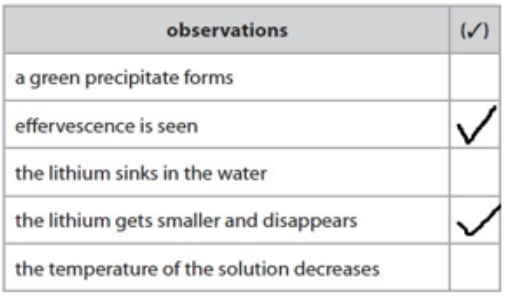
Question number	Answer	Mark
(ii)	**D** to kill any bacteria in the water is the only correct answer **A**, **B**, **C** are not reasons why chlorine is added	**(1) AO 1-1**

Question number	Answer	Additional guidance	Mark
(iii)	any one from • ions {present / make test invalid} • the water is impure • tap water would interfere with analysis	allow named substances that could be present in tap water eg calcium ions / chlorine / chloride ions / magnesium ions / minerals allow (water) is not pure ignore 'sterile' / 'contains chemicals' / 'not clean' / 'contains bacteria' ignore any substances not found in tap water	(1) AO 1-1

(**Q02b 1SC0/1CF, June 2024**)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	from green to {purple / blue}	reject colours in reverse order allow named shades e.g. light green, dark blue reject any other colours given	AO2 2 (1)

Question number	Answer	Additional guidance	Mark
(ii)	 	if 1-2 ticks: 1 mark per correct tick if 3 ticks: 1 mark only if **both** correct ticks included if 4-5 ticks: 0 marks	AO1 2 (2)

Question number	Answer	Mark
(iii)	**C** hydrogen is the only correct answer **A**, **B** and **D** are incorrect because hydrogen is formed when sodium reacts with water	AO1 1 (1)

Question number	Answer	Additional guidance	Mark
(iv)	a description to include: • loses **electron**(s) (1) • **{one / an}** (electron) (1)	reject shares electron(s) for MP1 and MP2 ignore mention of any bonding type allow {transfers / donates / gives away} electron(s)	**AO1 1 (2)**

Question number	Answer	Additional guidance	Mark
(v)	4.166666...**correctly rounded** with or without working scores 3 7 + 16 + 1 = 24 (1) $\frac{1}{24}$ (= 0.0416666666) (1) 0.0417 x 100 = 4.2 (1)	4.16 scores 3 marks with or without working 24 seen scores 1 allow ECF from Mr calculated by adding at least two Ar with working allow ECF to MP3 using $\frac{1}{Mr}$ x 100 or $\frac{2}{Mr}$ x 100 only	**AO2 1 (3)**

(**QU04b 1SC0/2CF, June 2025**)

Q6.

Question number	Answer	Additional guidance	Mark
(i)	thermometer	ignore temperature probe	**(1) AO2 2**

Question number	Answer	Additional guidance	Mark
(ii)	stops polystyrene cup from falling over	allow keeps {heat / thermal energy} {in / out} allow provides insulation ignore references to keeping temperature in ignore prevents burns / too hot to pick up	(1) AO3 1

Question number	Answer	Additional guidance	Mark
(iii)	reduces {heat/thermal energy} loss / traps heat	allow maintains the temperature allow reduces {heat / thermal energy} gain allow insulation ignore references to keeping temperature in ignore references to cold {entering/leaving} polystyrene cup	(1) AO3 1

Question number	Answer	Additional guidance	Mark
(iv)	salt R: (+) 3(.0) (1) salt S: -1.5 (2) salt with most negative value **only** ticked (1)	reject - 3(.0) for MP1 (+)1.5 scores 1	(4) AO2 2

Question number	Answer	Additional guidance	Mark
(v)	Ba2+	allow Ba^{+2} / Ba2+ ignore any other ions reject subscript reject incorrect cases	(1) AO2 1

(**QU02b 1SC0/2CF, June 2024**)

Q7.

Question number	Answer	Mark
(i)	An answer that provides a description by making reference to: • one electron (transferred) (1) • transferred from sodium to fluorine (1)	(2)

Question number	Answer	Mark
(ii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • (both solid and molten) contained charged particles/ions (1) • (ions) free to move in molten but not in solid (1)	(2)

(**Q05d 1SC0/2CF/S2, SAM**)

Q8.

Question number	Answer	Mark
(i)	An answer that provides a description by making reference to: • one electron (transferred) (1) • transferred from sodium to fluorine (1)	(2)

Question number	Answer	Mark
(ii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • (both solid and molten) contained charged particles/ions (1) • (ions) free to move in molten but not in solid (1)	(2)

(**Q01d 1SC0/2CH/S2, SAM**)

Q9.

	Answer	Acceptable answers	Mark
(a)(i)	C T		(1)
(a)(ii)	C Q and S		(1)
(b)(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	(1)

(b)(ii)	An explanation including • (atoms of) both contain 5 /same number of protons/same atomic number (1) • boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	ignore electrons boron-11 atoms contain 1 more neutron / boron-10 atoms contain 1 less neutron	**(2)**
(c)(i)	An explanation including the following • M1 {average/mean} mass (of atoms of an element) (1) • M2 compared to {1/12 mass carbon-12 (atom)/ (mass of) carbon-12 (atom) taken as 12} (1)	For M1 reject weight reject if mass of molecule reject if mass of neutrons and protons any reference to carbon-12 scores mark	**(2)**
(c)(ii)	[19.7 × 10] (1) +[80.3 × 11] (1) /100 (1) (=10.8) [0.197 ×10] (1) + [0.803 ×11] (1) = [1.97 + 8.83] (1) (=10.8)	If no working shown 10.8(03) worth 3 marks	**(3)**

(**Q14 1SC0/1CH, June 2013**)

Q10.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	C T		**(1)**
(a)(ii)	C Q and S		**(1)**
(b)(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	**(1)**
(b)(ii)	An explanation including • (atoms of) both contain 5 /same number of	ignore electrons	**(2)**

	protons/same atomic number (1) • boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	boron-11 atoms contain 1 more neutron / boron-10 atoms contain 1 less neutron	
(c)(i)	An explanation including the following • M1 {average/mean} mass (of atoms of an element) (1) • M2 compared to {1/12 mass carbon-12 (atom)/ (mass of) carbon-12 (atom) taken as 12} (1)	For M1 reject weight reject if mass of molecule reject if mass of neutrons and protons any reference to carbon-12 scores mark	**(2)**
(c)(ii)	[19.7 × 10] (1) +[80.3 × 11] (1) /100 (1) (=10.8) [0.197 ×10] (1) + [0.803 ×11] (1) = [1.97 + 8.83] (1) (=10.8)	If no working shown 10.8(03) worth 3 marks	**(3)**

(**Q04 1SC0/2CH, June 2013**)

Q11.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	$BaSO_4$	SO_4Ba ignore charges unless incorrect	**(1)**
(a)(ii)	charged particle	charged atom / {particle/atom(s)} that has gained or lost electrons ignore any stated charges	**(1)**
(b)	An explanation linking two of the following points: • barium sulfate does not dissolve (in water) (1) • is not absorbed into blood	 ignore barium sulfate is insoluble in water {mix with / enter} blood allow 'barium sulfate does not dissolve into the bloodstream' for 2 marks	**(2)**

	/ body (1) • passes through body (unchanged) (1)	allow 'it is insoluble so it is nontoxic' for one mark	

		Indicative Content	
QWC	***(c)**	A description including some of the following points **reactants** • dissolve reactants (in water) • mix reactants / solutions • use of appropriate apparatus • stir **separate product** • filter • use of filter funnel and paper **making pure dry salt** • solid on filter paper • wash with water • dry in oven / leave to dry / in a warm place	

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple description e.g. mix solutions of the reactants in a beaker and then filter. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description e.g. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

	Answer	Acceptable answers	Mark
(d)	$Ba + Cl_2$ (→) (1) → BaC_{l2} (1) reactants = 1 product = 1	max 1 for any incorrectly balanced equation	**(2)**

Q12.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	$BaSO_4$	SO_4Ba ignore charges unless incorrect	**(1)**
(a)(ii)	charged particle	charged atom / {particle/atom(s)} that has gained or lost electrons ignore any stated charges	**(1)**
(b)	An explanation linking two of the following points: • barium sulfate does not dissolve (in water) (1) • is not absorbed into blood / body (1) • passes through body (unchanged) (1)	ignore barium sulfate is insoluble in water {mix with / enter} blood allow 'barium sulfate does not dissolve into the bloodstream' for 2 marks allow 'it is insoluble so it is nontoxic' for one mark	**(2)**

		Indicative Content	
QWC	***(c)**	A description including some of the following points **reactants** • dissolve reactants (in water) • mix reactants / solutions • use of appropriate apparatus • stir **separate product** • filter • use of filter funnel and paper **making pure dry salt** • solid on filter paper • wash with water • dry in oven / leave to dry / in a warm place	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • the answer communicates ideas using simple language and uses limited scientific terminology	

		• spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. mix solutions of the reactants in a beaker and then filter. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

	Answer	**Acceptable answers**	**Mark**
(d)	$Ba + Cl_2$ (→) (1) → BaC_{l2} (1) reactants = 1 product = 1	max 1 for any incorrectly balanced equation	**(2)**

(**Q05 1SC0/2CF, June 2013**)

Q13.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A description including carbon (1) atom(s) (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	covalent Ignore giant molecular		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	fractional distillation (2)	distillation fractionation	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	**A** 0.25		**(1)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description/explanation including some of the following points content could be shown in diagram(s) **practical procedure** • ignite magnesium /put magnesium in (Bunsen) flame • use of tongs/crucible / tube or gas jar of {oxygen/air} • lift lid (to let air in)- if crucible used • magnesium burns/oxidises/exothermic reaction • (bright) white {flame/light} • white powder/ash/solid formed **bonding** • magnesium atoms have 2 electrons in the outer shell • magnesium atoms {lose/transfer} electrons • form Mg^{2+}/ions with positive charge • oxygen atoms have 6 electrons in the outer shell • oxygen atoms gain electrons • forms O^{2-}/ions with negative charge • {8 electrons in /full/complete} outer shell • two electrons transferred/gained/lost • ions with opposite charges attract each other/ Mg^{2+} attracts O^{2-} ions	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium burns / magnesium atoms lose electrons • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. magnesium burns with a white flame / magnesium forms positive ions and oxygen forms negative ions • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description including the experiment and bonding e.g. magnesium burns with a white flame, magnesium atoms give their 2 outer electrons to oxygen atoms • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question = 12 marks)

(**Q05 1SC0/1CF, June 2014**)

Q14.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A description including carbon (1) atom(s) (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	covalent Ignore giant molecular		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	fractional distillation (2)	distillation fractionation	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	**A** 0.25		**(1)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description/explanation including some of the following points content could be shown in diagram(s) **practical procedure** • ignite magnesium /put magnesium in (Bunsen) flame • use of tongs/crucible / tube or gas jar of {oxygen/air} • lift lid (to let air in)- if crucible used • magnesium burns/oxidises/exothermic reaction • (bright) white {flame/light} • white powder/ash/solid formed **bonding** • magnesium atoms have 2 electrons in the outer shell • magnesium atoms {lose/transfer} electrons • form Mg^{2+}/ions with positive charge • oxygen atoms have 6 electrons in the outer shell • oxygen atoms gain electrons • forms O^{2-}/ions with negative charge • {8 electrons in /full/complete} outer shell • two electrons transferred/gained/lost • ions with opposite charges attract each other/ Mg^{2+} attracts O^{2-} ions	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium burns / magnesium atoms lose electrons • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. magnesium burns with a white flame / magnesium forms positive ions and oxygen forms negative ions • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description including the experiment and bonding e.g. magnesium burns with a white flame, magnesium atoms give their 2 outer electrons to oxygen atoms • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question = 12 marks)

(**Q05 1SC0/2CF, June 2014**)

Q15.

Question number	Answer	Mark
	number of protons = 52 (1) number of neutrons = 125 - number of protons (1) (= 73)	(2) AO2

(**Q06a 1SC0/1CH, Nov 2021**)

Q16.

Question number	Answer	Additional guidance	Mark
	$Al^{3+} + PO_4^{3-} \rightarrow AlPO_4$ (2) Al^{3+} (1) $AlPO_4$ (1)	allow any neutral aluminium phosphate formula based on their aluminium ion. allow $Al^{3+}PO_4^{3-}$	(2) AO2

(**Q02d 1SC0/1CH, Nov 2021**)

Q17.

Question number	Answer	Additional guidance	Mark
	A description including • {silver nitrate / solution} has **ions** (1) • {silver / solid / metal} has **delocalised electrons** • (1) • {ions / electrons} move (1)	reject silver nitrate has electrons {that move / delocalised} for MP1 allow {free / sea of} electrons reject <u>silver</u> has ions {that move / delocalised} for MP2 allow charged particles move MP3 for idea of movement of charge (even if, for example, MP1 and/or MP2 reversed or wrong)	**(3)** **AO2-1**

(**QU06b 1SC0/1CF, June 2025**)

Q18.

Question number	Answer	Additional guidance	Mark
	A description including • {silver nitrate / solution} has **ions** (1) • {silver / solid / metal} has **delocalised electrons** (1) • {ions / electrons} move (1)	reject silver nitrate has electrons {that move / delocalised} for MP1 allow {free / sea of} electrons reject silver has ions {that move / delocalised} for MP2 allow charged particles move MP3 for idea of movement of charge (even if, for example, MP1 and/or MP2 reversed or wrong)	**(3)** **AO2-1**

(**QU02b 1SC0/1CH, June 2025**)

Q19.

Question number	Answer	Additional guidance	Mark
	A description to include ionic (max 2 marks) • (electrostatic) force between (oppositely charged) ions / between anions and cations (2) covalent (max 2 marks) • atoms share a **pair** of electrons (2)	Other creditable responses (max 1 mark) including any **one** from: • {ions / cations / anions} are charged particles • ionic bonds between metals and non-metals • electrons transferred (from metal to non-metal) • metals lose electrons / non-metals gain electrons reject electrons transferred from non-metal to metals Other creditable responses (max 1 mark) including any **one** from: • covalent bonds are formed when electron(s) are shared • covalent bonds form molecules • covalent bonds between non-metals	**AO1-1** **(4)**

(**Q04d 1SC0/1CF, June 2023**)

Q20.

Question number	Answer	Additional guidance	Mark
(i)	A description to include • use of **glowing** splint (1) • (glowing splint) relights (1)	 2nd mark dependent on correct test	**(2)** **AO1**

Question number	Answer	Additional guidance	Mark
(ii)	potassium ion: 2.8.8 (1) oxide ion: 2.8 (1)	Allow other separators between the numbers including spaces	**(2)** **AO1**

(**Q03c 1SC0/2CH, Nov 2021**)

Q21.

Question number	Answer	Mark
	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	 **(4)**

(**Q06b 1SC0/1CF, SAM 2016**)

Q22.

Question number	Answer	Mark
	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	(4)

(**Q02c 1SC0/1CH, SAM 2016**)

Q23.

			Indicative Content	
QWC		*	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions • due to opposite charges • ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content		
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy		
2	**3 - 4**	• a simple description e.g. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • the answer communicates ideas showing some evidence of clarity		

		and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description e.g. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O^{2-}) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(**Q27 1SC0/1CH, June 2013**)

Q24.

		Indicative Content	
QWC	*	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions • due to opposite charges • ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form	

		negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O^{2-}) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q18 1SC0/2CH, June 2013**)

Q25.

Question Number	Answer	Additional guidance	Mark
	barium and sulfur	both elements must be present for the mark allow Ba and S reject sulfide/sulfate reject if any other elements included	**(1)** AO 2 1

(**Q10 1SC0/1CF, June 2018**)

Q26.

Question Number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • sodium atoms lose electrons • each sodium atom loses one electron • to obtain electronic configuration 2.8 • which is that of sodium ions, Na^+ • electrons transfer to chlorine atoms • chlorine atoms gain electrons • each chlorine atom gains one electron • to obtain electronic configuration 2.8.8 • which is that of chloride ions, Cl^- • sodium ions attract chloride ions • because of opposite charges • ions pack close together • ratio of ions 1:1 • ions arranged in lattice • giant (ionic) (structure)	**(6)**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by use of the information will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Describes how ions are formed by loss or gain of electrons **OR** identifies structure type of sodium chloride	Possible candidate responses • atoms {lose / gain} electrons • sodium chloride has a giant structure • loose description of a solid ionic structure
Level 2	3–4	Additional guidance Describes formation of sodium ions by loss of electrons **or** describes formation of chloride ions by gain of electrons **OR** Describes formation of one ion using electron configurations **OR** Describes structure type of sodium chloride **OR** Basic description of ion formation and identifies sodium chloride structure	Possible candidate responses • sodium loses electrons and chlorine gains electrons to form ions • sodium loses {electrons / 1 electron} to form sodium ions [incorrect number of electrons lost puts this at the bottom of the level] • chlorine gains {electrons / 1 electron} to form **chloride** ions [incorrect number of electrons gained or '**chlorine** ions' puts this at the bottom of the level] • electron shell diagram showing atoms forming ions for either sodium or for chlorine
Level 3	5–6	Additional guidance Describes formation of sodium and chloride ions by loss or gain of electrons **AND** describes formation of ions using electron configurations. **or** Describes structure of sodium chloride	Possible candidate responses • {sodium / Na} atoms lose 1 electron to form {sodium ions / Na^+ (ions)} and {chlorine / Cl} atoms gain 1 electron to form {chloride ions / Cl^- (ions)} AND • Na : 2.8.1 becomes Na^+ : 2.8 and Cl : 2.8.7 becomes Cl^- : 2.8.8 OR as electron shell diagrams showing electron transfer or • sodium and chloride ions have opposite charges and attract each other (to make a giant structure) (could be shown in a diagram)

(**Q06d 1SC0/2CF, June 2019**)

Q27.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • in calcium the outermost electron(s) {are further away from nucleus/experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • therefore less attraction between nucleus and electron(s)/the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium.	**(2)**

(**Q05f 1SC0/2CF, SAM 2016**)

Q28.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • In calcium the outermost electron(s) {are further away from nucleus /experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • Therefore less attraction between nucleus and electron(s)/ the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium	**(2)**

(**Q02c 1SC0/2CH, SAM 2016**)

Q29.

Question number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • solid calcium chloride contains ions/cations/anions which are charged particles • solid calcium chloride does not conduct because charged particles are not free to move because they are held together by strong electrostatic forces/ionic bonds in lattice • molten calcium chloride solution conducts because ions/cations/anions are present which are charged particles and are free to move • the ions have separated and move to electrode of opposite charge • diamond does not conduct because it is giant molecular covalent with no free electrons • outer electrons of carbon atoms used in bonding • zinc metallic structure consists of delocalised free electrons which can move between layers of metals atoms/cations

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO4) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

(**Q06c 1SC0/1CF, SAM 2016**)

Q30.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • (redox involves both) reduction **and** oxidation (1) • magnesium (atoms) loses electrons (and are oxidised) (1) • titanium **ions** accept electrons (and are reduced) (1)	ignore references to loss and gain of oxygen allow Mg → $Mg^{2+} + 2e^{(-)}$ allow $Ti^{4+} + 4e^{(-)} \rightarrow Ti$ If no other mark awarded, then allow description of what happens to both reactant particles without mention of electrons (1) OR allow titanium gains electrons and magnesium loses electrons (1)	**(3)** AO1-1

Question number	Answer	Mark
(ii)	**C** $Ti(SO_4)_2$ is the only correct answer **A**, **B** and **D** are incorrect formulae	**(1)** AO1-1

(**QU04b 1SC0/1CH, June 2022**)

Q31.

Question number	Answer	Additional guidance	Mark
(i)	2.8.8.1	allow any separator including gaps *e.g.* 2 8 8 1 send to review any diagrams	(1)

Question number	Answer	Mark
(ii)	B 19 (protons) 20 (neutrons) This is the only correct answer. A is incorrect because there are 20 neutrons in the ion C is incorrect because there are 19 protons and 20 neutrons D is incorrect because there are 19 protons in the ion	(1)

(**Q05a 1SC0/2CF, Nov 2020**)

Q32.

Question number	Answer	Additional guidance	Mark
(i)	**2.8.8.1**	allow any separator including gaps *e.g.* 2 8 8 1 send to review any diagrams	**(1)**

Question number	Answer	Mark
(ii)	**B** 19 (protons) 20 (neutrons) is the only correct answer. **A** is incorrect because there are 20 neutrons in the ion **C** is incorrect because there are 19 protons and 20 neutrons **D** is incorrect because there are 19 protons in the ion	**(1)**

(**Q01a 1SC0/2CH, Nov 2020**)

Q33.

Question number	Answer	Additional guidance	Mark
	Na^+ 2.8 (1) Cl^- 2.8.8 (1)	allow any separator e.g. 2,8 send any atom diagrams to review allow Na^+ 2.8.0 (1) Cl^- 2.8.8.0 (1)	**(2)**

(**Q02d 1SC0/2CH, June 2019**)

Q34.

Question Number	Answer	Additional guidance	Mark
(i)	any two from **E, G** and **X**	allow mark if all three given for E allow B / boron for G allow O / O_2 / oxygen for X allow Ar / argon allow use of lower case letters reject answers with any other letters / element names	**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	any two from **A, E** and **G**	allow mark if all three given for A allow Li / lithium for E allow B / boron for G allow O / O_2 / oxygen allow use of lower case letters reject answers with any other letters / element names	**(1)**

Question Number	Answer	Additional guidance	Mark
(iii)	**A / J**	allow mark if both given for A allow Li / lithium for J allow Na / sodium allow use of lower case letters reject answers with any other letters / element names reject answers with + or – charges	**(1)**

(**Q05a 1SC0/1CF, June 2019**)

Q35.

Question number	Answer	Additional guidance	Mark
(i)	any two from **E, G** and **X**	allow mark if all three given for E allow B / boron for G allow O / O_2 / oxygen for X allow Ar / argon allow use of lower case letters reject answers with any other letters / element names	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	any two from **A, E** and **G**	allow mark if all three given for A allow Li / lithium for E allow B / boron for G allow O / O_2 / oxygen allow use of lower case letters reject answers with any other letters / element names	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	**A / J**	allow mark if both given for A allow Li / lithium for J allow Na / sodium allow use of lower case letters reject answers with any other letters / element names reject answers with + or – charges	**(1)**

(**Q01a 1SC0/1CH, June 2019**)

Q36.

Question number	Answer	Mark
(i)	A / thermometer	**(1)** **AO2 2**

Question number	Answer	Additional guidance	Mark
(ii)	**beaker**	allow measuring beaker/ plastic beaker reject measuring cup/ jug	**(1)** **AO2 2**

Question number	Answer	Additional guidance	Mark
(iii)	it is a (good heat) insulator	allow would hold / trap heat / keeps heat in / doesn't absorb heat / reduces heat loss / poor conductor allow correct comparison of heat conductivity with glass e.g polystyrene is a better insulator than glass ignore keeps temperature in / heat resistant ignore not breakable / glass is breakable ignore 'traps energy' alone	**(1) AO2 2**

Question number	Answer	Additional guidance	Mark
(iv)	-2.5℃ scores 3 with or without working 16.1 – 18.6 (1) = -2.5 (1) ℃ (1)	2.5℃ scores 2 with or without working 2.5 scores 1 with or without working MP3 standalone mark ignore 'C' / 'o' alone ignore 'deg C'	**(3) AO2 1**

Question number	Answer	Additional guidance	Mark
(v)	formula: NH_4NO_3 (1) name: ammonium nitrate (1)	letters must be capitals and 4, 3 must be subscripts allow $NH_4^+NO_3^-$ allow $N_2H_4O_3$ ignore state symbols ignore $NH_4^+ + NO_3^-$ reject ammonia nitrate	**(2) AO2 1**

(**QU02b 1SC0/2CF, June 2019**)

Q37.

Question number	Answer	Mark
(i)	A / thermometer	(1) AO2 2

Question number	Answer	Additional guidance	Mark
(ii)	**beaker**	allow measuring beaker/ plastic beaker reject measuring cup/ jug	(1) AO2 2

Question number	Answer	Additional guidance	Mark
(iii)	it is a (good heat) insulator	allow would hold / trap heat / keeps heat in / doesn't absorb heat / reduces heat loss / poor conductor allow correct comparison of heat conductivity with glass e.g polystyrene is a better insulator than glass ignore keeps temperature in / heat resistant ignore not breakable / glass is breakable ignore 'traps energy' alone	(1) AO2 2

Question number	Answer	Additional guidance	Mark
(iv)	-2.5℃ scores 3 with or without working 16.1 – 18.6 (1) = -2.5 (1) ℃ (1)	2.5℃ scores 2 with or without working 2.5 scores 1 with or without working MP3 standalone mark ignore 'C' / 'o' alone ignore 'deg C'	(3) AO2 1

Question number	Answer	Additional guidance	Mark
(v)	formula: NH_4NO_3 (1) name: ammonium nitrate (1)	letters must be capitals and 4, 3 must be subscripts allow $NH_4^+NO_3^-$ allow $N_2H_4O_3$ ignore state symbols ignore $NH_4^+ + NO_3^-$ reject ammonia nitrate	(2) AO2 1

Q38.

Question Number	Indicative content	Mark
*	An explanation that combines identification - knowledge (3 marks) and reasoning/justification - understanding (3 marks) • each magnesium atom loses electrons • two (electrons) • to form magnesium cation / Mg^{2+} • $Mg \rightarrow Mg^{2+} + 2e^{(-)}$ • electrons transferred from magnesium atoms to oxygen atoms • each oxygen atom gains electrons • two (electrons) • to form oxide anion / O^{2-} • $O + 2e^{(-)} \rightarrow O^{2-}$ • ionic bonds form • (ionic bonds form) between oppositely charged ions • strong electrostatic forces • between oppositely charged ions • regular arrangement of ions / lattice structure • require large amounts of energy to separate (hence high melting point)	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

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Q39.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

(**Q06a 1SC0/1CF, SAM 2016**)

Q40.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

(**Q02a 1SC0/1CH, SAM 2016**)