Questions

Q1.

An ion of element X can be represented as

$$^{125}X^{2-}$$

This ion of element X has 54 electrons.

Calculate the number of protons and the number of neutrons in this ion.

(2)

number of protons .....

number of neutrons .....

(Total for question = 2 marks)

Q2.

Calcium oxide is an ionic solid.

Figure 5 shows the arrangement of electrons in a calcium atom and in an oxygen atom.

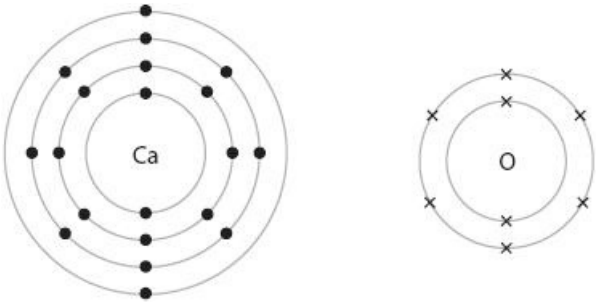
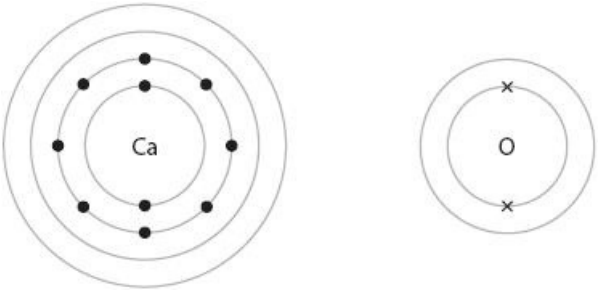


Figure 5

Complete Figure 6 to show the electronic configurations and charges of the calcium ion and the oxide ion.
Use dots to show the electrons originally in the calcium atom and crosses to show the electrons originally in the oxygen atom.

(3)



charge on ion ..... charge on ion .....

Figure 6

(Total for question = 3 marks)

Q3.

Waste water may contain phosphate ions, PO_4^{3-} .

Aluminium ions react with phosphate ions to form aluminium phosphate.

Complete the ionic equation for the formation of aluminium phosphate in this reaction.

(2)

..... + PO_4^{3-} → .....

(Total for question = 2 marks)

Q4.

* Figure 6 shows some properties of three substances, A, B and C.

substance	melting point in °C	ability to conduct electricity	
		solid	molten
A	1180	poor	good
B	1538	good	good
C	115	poor	poor

Figure 6

Deduce, using the information in Figure 6, the structure and bonding of substances A, B and C, explaining their properties in terms of their structure and bonding.

(6)

(Total for question = 6 marks)

Q5.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

The method used to extract a metal from its ore depends on the position of the metal in the reactivity series.

(i) One step in the extraction of titanium metal involves the displacement reaction between titanium chloride, $TiCl_4$, and magnesium.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

This equation can be simplified as

$$Ti^{4+} + 2Mg \rightarrow Ti + 2Mg^{2+}$$

Explain why this displacement reaction can be described as a redox reaction.

(3)

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(ii) The formula of the sulfate ion is SO_4^{2-}.

Which of the following is the formula of titanium sulfate containing the Ti^{4+} ion?

(1)

- ☒ A $TiSO_4$
- ☒ B Ti_2SO_4
- ☒ C $Ti(SO_4)_2$
- ☒ D $Ti_2S_2O_8$

(Total for question = 4 marks)

Q6.

Figure 1 shows the dot and cross diagram for a molecule of ammonia.

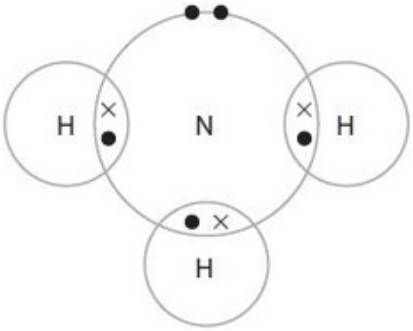

Figure 1

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

..... + ... → .....

(ii) An ammonium ion has the formula NH_4^+.

A nitrate ion has the formula NO_3^-.
Which of the following is the formula for ammonium nitrate?

(1)

- ☒ A (NH)4NO3
- ☒ B (NH4NO)3
- ☒ C NH4NO3
- ☒ D (NHNO)12

(iii) Explain why farmers spread ammonium nitrate on their fields.

(2)

.....

.....

(Total for question = 4 marks)

Q7.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Magnesium carbonate has the formula $MgCO_3$.

Magnesium carbonate contains Mg^{2+} and CO_3^{2-} ions.

(i) The atomic number of magnesium is 12.

What is the electronic configuration of the Mg^{2+} ion?

(1)

- ☐ A 2 2.8
- ☐ B 2.8.2
- ☐ C 2.8.4
- ☐ D

(ii) Explain why solid magnesium carbonate cannot conduct electricity but solid magnesium can.

(3)

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(Total for question = 4 marks)

Q8.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

When copper sulfate solution reacts with sodium hydroxide solution, a precipitate of copper hydroxide and a solution of sodium sulfate are formed.

The equation is

$$CuSO_4 + 2NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$$

The formula of the sodium ion is Na^+.

What is the formula of the sulfate ion?

(1)

☐ A SO^{+4}

☐ B SO^{-4}

☐ C SO_2^+

☐ D SO_4^{2-}

(Total for question = 1 mark)

Q9.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Magnesium has an atomic number of 12.

Which line in the table shows the correct numbers of protons, neutrons and electrons in a positively charged magnesium ion?

(1)

	number of		
	protons	neutrons	electrons
☐ A	10	12	12
☐ B	10	12	10
☐ C	12	10	12
☐ D	12	12	10

(Total for question = 1 mark)

Q10.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

Sodium sulfate, Na2SO4, is an ionic solid.

(i) Which of these is most likely to be a property of solid sodium sulfate?

(1)

☐ A good conductor of electricity

☐ B high melting point

☐ C low boiling point

☐ D malleable

(ii) The formula of the sodium ion is Na+.

What is the formula of the sulfate ion?

(1)

☐ A SO+4

☐ B SO−4

☐ C SO2+4

☐ D SO2−4

(iii) Explain, in terms of electrons, how a sodium atom, Na, forms a sodium ion, Na+.

(2)

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(Total for question = 4 marks)

Q11.

Salts of metals can be prepared by reacting the metal with an acid to produce the salt and hydrogen.

(i) Describe the test to show that the gas is hydrogen.

(2)

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(ii) Nickel is a metal.

Explain how the structure of a nickel atom, Ni, changes when it forms a nickel ion, Ni^{2+}.

(2)

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(Total for question = 4 marks)

Q12.

Potassium carbonate reacts with dilute sulfuric acid to form potassium sulfate.

(i) Potassium sulfate contains potassium ions, K+, and sulfate ions, SO_4^{2-}.

Write the formula of potassium sulfate.

(1)

.....

(ii) Equal volumes of a solution of potassium carbonate were reacted separately with an excess of dilute sulfuric acid solution.
Pure dry samples of potassium sulfate were obtained from the resulting solutions.

The experiment was repeated three times using the same conditions.
The masses of potassium sulfate obtained were
experiment 1 = 5.22 g
experiment 2 = 5.24 g
experiment 3 = 5.21 g

Calculate the mean mass of potassium sulfate obtained, giving your answer to two decimal places.

(2)

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mean mass of potassium sulfate = ... g

(Total for question = 3 marks)

Q13.

Figure 11 shows the apparatus that can be used to electrolyse sodium sulfate solution using inert electrodes.

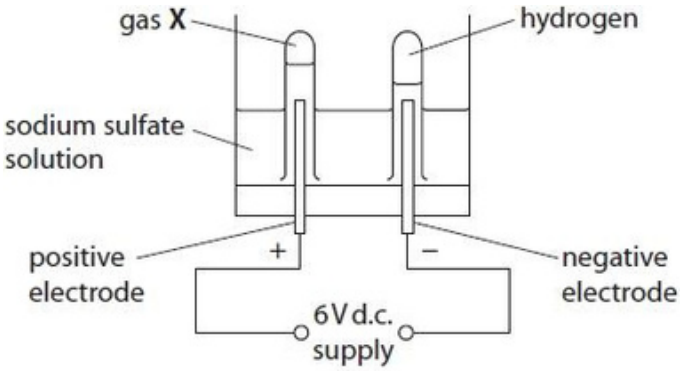

Figure 11

The ions present in sodium sulfate are

sodium	Na^+
sulfate	SO_4^{2-}

Write the formula of sodium sulfate using this information.

(1)

.....

(Total for question = 1 mark)

Q14.

In an experiment, a solid is mixed with a liquid.
The temperature change of the mixture is measured.

Figure 3 shows the apparatus that is used.

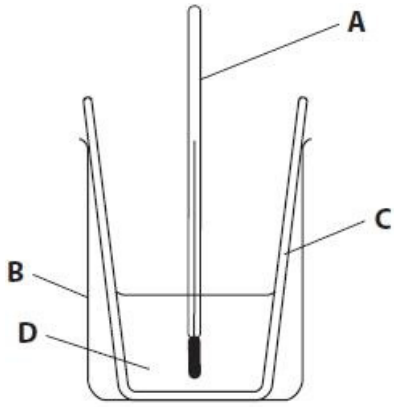

Figure 3

(i) Give the letter of the piece of apparatus, A, B, C or D, in Figure 3 that is used to measure the temperature.

(1)

.....

(ii) Give the name of the piece of apparatus B shown in Figure 3.

(1)

.....

(iii) The piece of apparatus labelled C is made from polystyrene.

State why polystyrene is a better material than glass for this piece of apparatus.

(1)

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(iv) The results of the experiment are given in Figure 4.

temperature of liquid at start in °C	18.6
temperature of products at end in °C	16.1

Figure 4

Calculate the change in temperature.
Give a sign and a unit in your answer.

(3)

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.....

temperature change = ...

(v) The solid used in this experiment contained only NH_4^+ ions and NO_3^- ions.

Give the formula and the name of the solid.

(2)

formula .....

name .....

(Total for question = 8 marks)

Q15.

A solid ionic compound is dissolved in water to form a solution.

Describe a simple experiment to show that charged particles are present in this solution.

(3)

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(Total for question = 3 marks)

Q16.

Two compounds of barium are barium sulfide and barium chloride.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

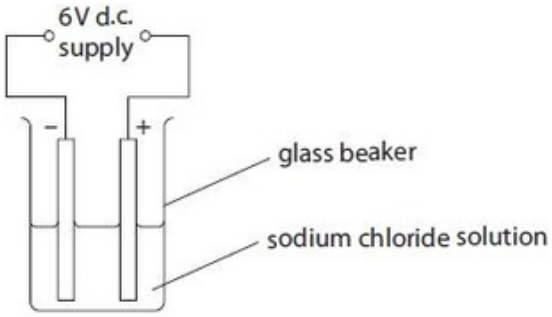

Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

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.....

(ii) The formulae of the ions present in the sodium chloride solution are

Na^+ Cl^- H^+ OH^-

Circle the ions that would be attracted to the anode.

(1)

(iii) Molten lead bromide can be electrolysed to form molten lead and bromine gas.

Explain how a student could modify the apparatus shown in Figure 8 to carry out this electrolysis.

(2)

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(Total for question = 4 marks)

Q17.

Sodium chloride is an ionic compound, containing sodium ions, Na+, and chloride ions, Cl–.

Figure 15 shows the electronic configuration of sodium and chlorine.

	electron configuration
sodium	2.8.1
chlorine	2.8.7

Figure 15

Explain how sodium and chlorine atoms form the ions in sodium chloride and how the ions are arranged in the solid sodium chloride.
You may wish to use diagrams in your answer.

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(Total for question = 6 marks)

Q18.

* Figure 12 shows the melting points of two substances, A and B, and the abilities of the substances to conduct an electric current when solid and when molten.

substance	melting point in °C	ability to conduct electric current	
		when solid	when molten
A	35	no	no
B	801	no	yes

Figure 12

One of the substances has an ionic structure and one has a simple molecular, covalent structure.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

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(Total for question = 6 marks)

Q19.

Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.
Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

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(Total for question = 2 marks)

Q20.

A student used the equipment in Figure 3 to investigate whether electricity can pass through solid ammonium chloride and through ammonium chloride solution.

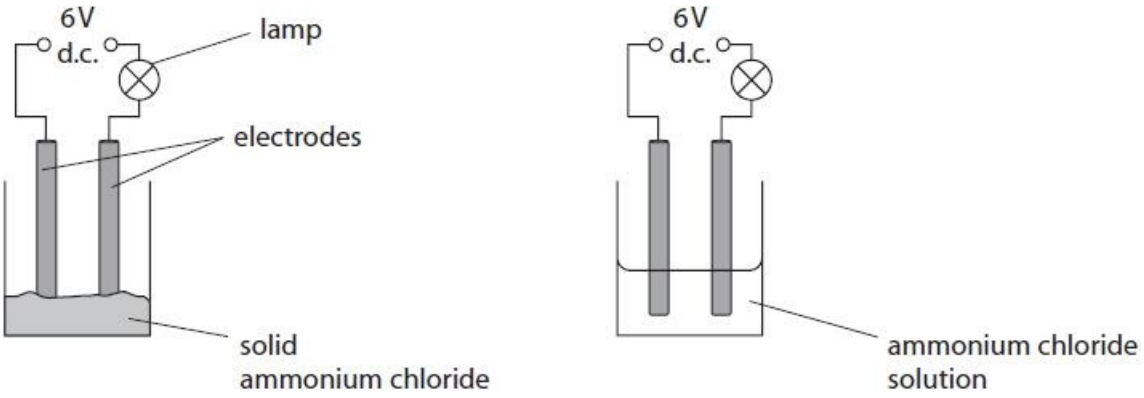

Figure 3

If an electrical current flows in the circuit, the lamp will light up.

Figure 4 shows the results of the investigation.

substance	lamp
solid ammonium chloride	did not light up
ammonium chloride solution	lit up brightly

Figure 4

Explain the results of the investigation.

(3)

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(Total for question = 3 marks)

Q21.

Part of the structure of potassium chloride is shown in Figure 6.

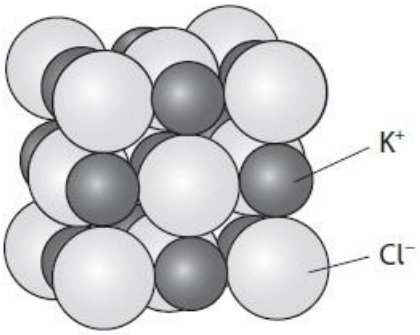

Figure 6

Potassium chloride has a melting point of 770°C.

Explain why potassium chloride has a high melting point.

(2)

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(Total for question = 2 marks)

Q22.

Sodium reacts with chlorine to form sodium chloride.

The electronic configuration of the sodium atom is 2.8.1 and the electronic configuration of the chlorine atom is 2.8.7.

Give the electronic configurations of the ions formed.

(2)

Na+ .....

Cl– .....

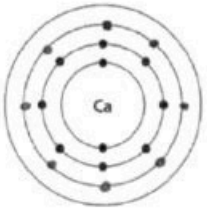
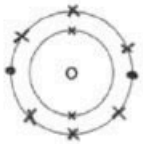
(Total for question = 2 marks)

Mark Scheme

Q1.

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

Q2.

Question number	Answer	Additional guidance	Mark
	  charge on ion +2 charge on ion -2 (3) • correct dots for calcium ion (1) • correct 2 dots and 6 crosses for the oxide ion (1) • correct charges 2+/+2 and 2-/-2 (1)	ignore arrows showing movement of electrons	(3) EXP

Q3.

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

Q4.

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. Substance A • giant ionic structure • (high melting point) strong electrostatic attractions between ions • due to a lot of energy required to overcome strong forces • (electrical conductivity) in solid ions strongly attracted in lattice ions cannot move, so poor conductor when solid • when molten ions free to move, so good conductor when molten Substance B • metallic structure • (high melting point) strong attraction between metal ions and delocalised electrons • due to a lot of energy required to overcome strong forces between particles in solid • (electrical conductivity) in solid delocalised electrons • free to move throughout metallic lattice, so good conductor when solid • delocalised electrons and ions free to move when molten, so good conductor when molten Substance C • covalent simple molecular • (low melting point) weak intermolecular forces/ attractions between molecules • little energy needed to separate molecules, so low melting point • (electrical conductivity) in solid and when molten no delocalised electrons or ions to carry charge, so poor conductor	(6) AO1 / AO3

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 detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Identifies correct structure types OR explains a property of one substance	Possible candidate responses • A – giant ionic, B – metallic, C – simple molecular • High mp (for A or B) due to strong bonds (between atoms / ions) • Low mp for C due to weak intermolecular forces • A conducts when molten – ions can move • B conducts when solid / molten – electrons can move • C does not conduct – no free ions or electrons can't move
Level 2	3–4	Additional guidance Identifies correct structure type for one substance AND explains at least one property of that substance OR explains at least two properties	Possible candidate responses • A – giant ionic AND high mp due to strong bonds between ions AND poor conductor when solid – ions not free to move; good conductor when molten – ions free to move • B – metallic AND high mp due to strong bonds between {atoms / metal ions and delocalised electrons} AND good conductor when solid and molten – electrons free to move • C – simple molecular AND low mp due to weak intermolecular forces AND poor conductor when solid and molten – no ions and electrons not free to move
Level 3	5–6	Additional guidance Identifies correct structure types and explains properties for least two substances	Possible candidate responses • A – giant ionic AND high mp due to strong bonds between ions AND poor conductor when solid – ions not free to move; good conductor when molten – ions free to move AND / OR • B – metallic AND high mp due to strong bonds between {atoms / metal ions and delocalised electrons} AND good conductor when solid and molten – electrons free to move AND / OR • C – simple molecular AND low mp due to weak intermolecular forces AND poor conductor when solid and molten – no ions and electrons not free to move

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. (AO3)
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) • Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently (AO3)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. (AO3)

Q5.

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

Q6.

Question Number	Answer	Additional guidance	Mark
(i)	ammonia + nitric acid → ammonium nitrate	accept reactants in either order ignore formula	(1) AO 2 1

Question Number	Answer	Mark
(ii)	C NH_4NO_3 **1. The only correct answer is C** ***A** is factually incorrect* ***B** is factually incorrect* ***D** is factually incorrect*	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation linking two from: • as a fertiliser (1) • contains (a high percentage of) nitrogen (1) • help promote plant growth / increases crop yield (1)	allow make crops grow faster ignore use as a pesticide	(2) AO 1 1

Q7.

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) AO1-1

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking • **ions** (in magnesium carbonate) {cannot move / in a fixed position / held in a lattice / held together by strong electrostatic forces} (1) • magnesium contains {delocalised/free} **electrons** (1) • electrons (in magnesium) can {flow / move} / are mobile (1)	ignore charged particles throughout allow magnesium carbonate does not have {delocalised / free} electrons reject references to covalent bonding in magnesium carbonate for MP1 allow sea of electrons ignore ions in magnesium ignore carry a {charge / current}	**(3)** AO2-1

Q8.

Question number	Answer	Mark
	D SO_4^{2-}	**(1)** **comp**

Q9.

Question number	Answer	Mark
	D 12 protons, 12 neutrons, 10 electrons	**(1)** **comp**

Q10.

Question number	Answer	Additional guidance	Mark
(i)	**B** high melting point		**(1)** **comp**

Question number	Answer	Mark
(ii)	D SO_4^{2-}	**(1)** **comp**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark): • loses electron(s) (1) • (loses) {one/an} (electron) (1)	allow transfers for loses mention of covalent bonding/sharing electrons = 0 ignore any reference to molecules.	(2)

Q11.

Question Number	Answer	Additional guidance	Mark
(i)	A description including • apply lighted splint (1) • (squeaky) pop (1)	allow flame / ignite gas / fire ignore 'squeaky pop test' / glowing splint second mark is dependent on first	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking • loss of electron(s) (1) • two electrons (1)	allow gains two electrons for 1 mark zero marks overall if sharing of electrons / gain or loss of protons / positive electrons marks can be awarded for suitably drawn diagram / half equation	(2) AO 1 1

Q12.

Question number	Answer	Additional guidance	Mark
(i)	K_2SO_4	allow SO_4K_2 allow $(K^+)_2SO_4^{2-}$ (both charges needed & allow in reverse) reject incorrect subscript and superscripts (both charges needed & allow in reverse) reject incorrect subscript and superscripts	(1)
(ii)	5.22 with or without working scores 2 $\frac{5.22 + 5.24 + 5.21}{3}$ (= 5.2233) (1) = 5.22 (1)	 5.22 + 5.24 + 5.21 = 15.67 (MP1 does not score) allow 15.67 (1) (*ie* not divided by 3 but MP2 scores as answer to 2dp)	(2)

Q13.

Question number	Answer	Additional guidance	Mark
	Na_2SO_4	allow SO_4Na_2 allow upper case A ignore any charges on ions reject non-subscript 2 & 4	(1)

Q14.

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**

Q15.

Question Number	Answer	Additional guidance	Mark
	A description to include the following points • insert electrodes (into aqueous solution)(1) • connect to electrical supply / powerpack /battery/cell (1) • bulb lights / ammeter shows current / electrolyte decomposes (1)	first two marks can be given for a suitable diagram allow anode **and** cathode allow carry out an electrolysis experiment alone / see if solution conducts electricity (1) allow pass an electric current through (the solution) (1) ignore electricity alone allow correct observation at one electrode (1)	**(3)** AO 3 3a

Q16.

Question Number	Answer	Additional guidance	Mark
(i)	so that the ions can move	allow the solid does not conduct allow conducts when {in solution/liquid} ignore conducts when molten allow so cations / anions can move ignore so particles can move reject electrons move	**(1)** AO 2 2

Question Number	Answer	Mark
(ii)	OH^- and Cl^- only circled	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation linking one of the following pairs of points • use a crucible/metal container (instead of a beaker) (1) • which will not break/melt (when heated strongly) (1) OR • add a Bunsen burner (under the container) (1) • because heat needed to melt the lead bromide / to make the lead bromide a liquid (1)	allow blow torch ignore hot water bath	**(2)** AO 3 3b

Q17.

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)

Q18.

Question number	Answer	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.	**(6)** **exp**

	AO2 (6 marks) Simple molecular substances have low melting points because • molecules (have) • weak (forces between molecules) • intermolecular forces • little energy needed to {separate the molecules / overcome the forces between molecules} (hence liquid at room temperature) they do not conduct whether solid or molten because • they do not contain any charged particles/ ions/ {delocalised/ free} electrons (hence does not conduct electricity) therefore • substance A is covalent Ionic substances have high melting points because • {charged particles/ ions} • strong (forces between ions) • electrostatic forces of attraction • a lot of (heat) energy is needed to {separate the ions / overcome the forces between ions} (hence high melting point) they conduct electricity when molten because • {ions/ charged particles} are present • free to move but they do not conduct when solid as • {ions/ charged particles} are present • not free to move therefore • substance B is ionic	

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. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q19.

Question number	Answer	Additional guidance	Mark
	An explanation linking: • (calcium) nitrate {is soluble/ dissolves}/ (calcium) carbonate {is insoluble/ does not dissolve} (1) • so **ions** {free to move in solution / not free in solid} (1)	calcium nitrate dissolves so ions can move (2) or reverse argument for calcium carbonate	(2)

Q20.

Question number	Answer	Additional guidance	Mark
	An explanation linking • ammonium chloride solution conducts electricity and solid ammonium chloride does not conduct electricity (1) • ammonium chloride contains **ions** (1) • in solution **ions** can move / in solid **ions** cannot move (1)	Answer must refer to both solid and solution for full marks	**(3)** **AO3**

Q21.

Question number	Answer	Additional guidance	Mark
	An explanation linking **EITHER** • {ionic / giant / lattice} structure (1) **OR** • strong forces of attraction (between ions of opposite charge) / strong (ionic) bonds (1) **AND** • (so) needs large amount of energy to overcome ionic forces (1)	reject covalent / molecular / intermolecular / atoms in the wrong context allow 'more energy' instead of 'large amount of energy' ignore temperature / heat	**(2)** AO2-1

Q22.

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)**