

Foundation

Question number	Description	Marks	Page number
4.1.1 Atomic model			
1	Atomic structure multiple choice, completing energy level diagram, explaining why atoms are neutral, matching state of matter with particle diagram	10	5
1	Naming parts of an atom, identify atom group from diagram, atomic number and mass from diagram, isotopes multiple choice	8	7
1	Separation method and name matching, suggesting improvement to separation apparatus, separation gap fill, percentage calculation from alloy diagram (4.2.2 alloys multiple choice), calculating volume of a cube	11	8
2	Completing table on sub atomic particles, determining number of sub atomic particles from a diagram, matching atomic model with stage in atomic model development	8	10
3	Atomic structure gap fill, A_r of isotope calculation, using periodic table to identify element calculated, calculating radius of nucleus when given radius of atom.	10	11
3	Identifying compounds, mixture etc from diagrams, matching separation methods and what is separated, drawing apparatus for separating sand and water, describing distillation to produce pure water from salt solution	13	12
6	Describing method to measure mass of dissolved salt in 25cm ³ of seawater	5	14
4.1.2 The periodic table			
2	Naming group 1 elements, suggesting safety precaution for lithium and water, giving two observations to describe trend in reactivity from a table of observation on group one reacting water, balancing sodium and water symbol equation, naming sodium hydroxide from symbol equation, predicting diameter of atom in a table, converting measurement in nanometres into standard form, describing trends in a graph	13	15

2	Describing trend in group one melting points from a graph, determining values from a graph, matching substances with description, balancing symbol equation, calculating M_r	9	17
2	Number of electrons in bromine outer shell, (4.2.1 bonding in hydrogen bromide), formula of fluorine gas, explaining reactivity of halogens in group 7 using results from table, calculating M_r of a compound, calculating percentage yield after converting units in the question	9	18
2	Group number of halogens, (4.2.1 drawing dot and cross diagram for fluorine molecule), complete word equation for halogen displacement reaction, displacement reaction gap fill, balancing symbol equation (4.2.2 explain why fluorine is a gas at room temperature)	13	20
3	Development of periodic table multiple choice and gap fill, (4.1.1 atomic structure recall and electron structure)	8	22
4	Balancing symbol equation, group one and seven gap fill, comparing size of potassium and sodium atoms	11	23
7	Completing word equation for sodium and oxygen, naming substance from symbol formula, calculating mass of compound in volume of concentration in g/dm^3 , plotting data from results table on graph, using graph to make a prediction	10	25
4.1.3 Properties of transition metals			
9	(4.1.1 number of subatomic particles for an atom), two differences between properties of group one and transition metal (4.4.1 explaining why carbon used to extract nickel from oxide), calculating percentage atom economy to three significant figures	11	27

Common content

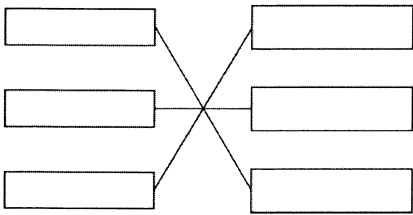
Question number	Description	Marks	Page number
4.1.2 The periodic table			
1	Why Mendeleev reversed position of elements, explaining why Mendeleev periodic table was accepted over previous versions, arrangement of elements in periodic table, formula and state of	10	29

	astatine at room temperature, describing reaction between sodium and chlorine		
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Higher

Question number	Description	Marks	Page number
4.1.1 Atomic model			
4	Completing table on sub atomic particles, define mass number, why mass is different in isotopes, explaining how alpha particle scattering experiment changed the plum pudding model of the atom	8	31
4	Multiple choice questions on model of the atom diagrams, define mass number, estimate A_r when given isotope abundances, explain how Chadwick's work led to a better understanding of the atom	8	32
4.1.2 The periodic table			
4	Order of elements in early periodic table, how Mendeleev overcame elements in wrong group, (4.2.2 explaining why halogens have low boiling points and trend in boiling points in group 7), electron structure of neon to explain why neon is unreactive, calculating how many atoms of argon are in 1g	11	33
4	(4.2.1 dot and cross diagram for fluorine), number of electrons in a fluorine atom, balancing symbol equation, explaining why chlorine is more reactive than bromine	9	35
4	(4.1.1 electron structure of sodium atom), safety precautions when reacting sodium with water, explaining how diameter of group one elements from a table affects reactivity	8	37
6	Balanced symbol equation for sodium reacting with chlorine, describing observations before, during and after reaction between sodium and chlorine, explain why sodium is less reactive than potassium (4.2 compare structure and bonding in NaCl and HCl – 6 marks)	14	38
4.1.3 Properties of transition metals			

8	<p>Titanium as transition metal is context, question very mixed.</p> <p>Hazard from a symbol equation of industrial reaction, reason why hazard if water comes into contact with sodium, suggesting reason argon used as atmosphere for reaction not air, (4.2.2 explaining why would not expect TiCl_4 to be liquid at room temperature), (4.2.1 describe oxidation and oxidation half equation) Explain using calculations limiting reactant in a given symbol equation, calculate actual mass from a percentage yield</p>	15	42
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8		allow 1 mark for one correct	2	AO1 4.1.1.1
Total			10	

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	A nucleus		1	AO1 4.1.1.4
	B electron		1	4.1.1.7
01.2	electron		1	AO1 4.1.1.5
01.3	3 / three		1	AO2 4.1.2.1
01.4	(atomic number) 5		1	AO2 4.1.1.5
	(mass number) 11		1	
01.5	isotope		1	AO1 4.1.1.5
01.6	there are the same number of $^{79}_{35}\text{Br}$ atoms and $^{81}_{35}\text{Br}$ atoms		1	AO2 4.1.1.6
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1 1 1	AO1 4.1.1.2
01.2	include a (filter) funnel	allow funnel drawn on the diagram ignore clamp stand	1	AO3 4.1.1.2
01.3	evaporate condense	must be this order	1 1	AO1 4.1.1.2
01.4	$\frac{2}{20} \times 100$ = 10 (%)	an answer of 10 (%) scores 2 marks an answer of 11.1(%) or 90 (%) scores 1 mark	1 1	AO2 4.2.2.7
01.5	an alloy		1	AO1 4.2.2.7
01.6	the layers in the mixture are distorted		1	AO1 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	8000 nm ³		1	AO2 4.2.4.1
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.												
02.1	<table><tr><th>name of particle</th><th>relative mass</th><th>charge</th></tr><tr><td>proton</td><td>(1)</td><td>(+1)</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr><tr><td>electron</td><td>(very small)</td><td>-1</td></tr></table>	name of particle	relative mass	charge	proton	(1)	(+1)	neutron	1	0	electron	(very small)	-1	allow words instead of numbers	1 + 1 1	AO1 4.1.2.3
	name of particle	relative mass	charge													
	proton	(1)	(+1)													
	neutron	1	0													
electron	(very small)	-1														
		allow neutral or no charge														
02.2	(protons) 3	allow words instead of numbers	1	AO2 4.1.2.3												
	(neutrons) 4		1													
	(electrons) 3		1													
02.3	<div><div>Description of atomic model</div><div>Stage in the development of the atomic model</div><div><div>A ball of positive charge with electrons embedded in it</div><div>Spherical atoms</div><div>Dalton atoms</div><div>Neutrons discovered</div><div>Nucleus of atoms discovered</div><div>Plum pudding model</div></div></div>		1 1	AO1 4.1.2.1												
Total			8													

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus	must be in this order	1	AO1 4.1.1.3 4.1.1.4 4.1.1.5
	neutron		1	
	neutron		1	
	electron		1	
	proton		1	
03.2	$(A_r) \frac{(63 \times 70) + (65 \times 30)}{100}$ = 63.6	an answer of 63.6 scores 2 marks	1	AO2 4.1.1.6
			1	
03.3	copper / Cu	allow ecf from answer to question 03.2	1	AO2 4.1.1.1
03.4	$\frac{1.2 \times 10^{-10}}{10\,000}$ or $1.2 \times 10^{-10} \times 1 \times 10^{-4}$ = 1.2×10^{-14} (m)	an answer of 1.2×10^{-14} (m) scores 2 marks a correct answer not in standard form scores 1 mark	1	AO2 4.1.1.5
			1	
Total			10	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	B		1	AO2 4.1.1.1 4.1.1.2
03.2	D		1	AO2 4.1.1.1 4.1.1.2
03.3	E		1	AO2 4.1.1.1 4.1.1.2
03.4	<div> <div>chromatography</div> <div>blue food colour from a mixture of food colours</div> <div>copper from an alloy of copper and zinc</div> <div>crystallisation</div> <div>copper sulfate from copper sulfate solution</div> <div>ethanol from a mixture of ethanol and water</div> </div> <p>additional line from a box negates the mark for that box</p>		1 1	AO2 4.1.1.2
03.5	<p>(filter) funnel containing filter paper</p> <p>suitable vessel for collecting filtrate</p> <p>sand and water labelled in correct place</p>		1 1 1	AO1 AO1 AO2 4.1.1.2
03.6	100 °C		1	AO2 4.1.1.2

03.7	<p>any four from:</p> <ul style="list-style-type: none">• solution is heated• water evaporates• the vapour cools in the condenser• the vapour condenses or the vapour turns to a liquid• (pure) water collects in the beaker	allow water boils / vaporises	4	AO1 4.1.1.2
Total			13	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	desalination		1	AO1 4.4.1.8
06.2	increased evaporation at location X		1	AO2 4.4.1.7
06.3	any one from: <ul style="list-style-type: none"> • (more) sewage • (more) industrial waste 	allow industrial pollution allow (more) fertiliser / run-off allow (more) desalination plants ignore less precipitation	1	AO2 4.4.1.8
06.4	weigh (evaporating) basin / dish add (25 cm ³ of) sea water (to evaporating dish) heat to evaporate / remove water (from evaporating dish) re-weigh subtract mass before from mass after	allow calculate the difference in mass (before and after heating)	1 1 1 1 1	AO1 4.4.1.8
Total			8	

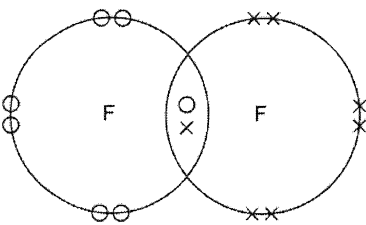
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	alkali metals		1	AO1 4.5.1.4
02.2	any one from: <ul style="list-style-type: none"> small piece of metal large volume of water use a (safety) screen keep a safe distance (between teacher / students and apparatus) 		1	AO3 4.5.1.4
02.3	reactivity increases down the group any two from: <ul style="list-style-type: none"> speed increases (down the group) sodium / potassium melts but lithium does not flame is seen with potassium, but no flame with lithium / sodium 		1 2	AO1 4.5.1.4 AO2 4.5.1.4
02.4	rubidium is too reactive	allow reaction would be violent	1	AO3 4.5.1.4
02.5	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$	allow correct multiples	1	AO2 4.5.2.1
02.6	sodium hydroxide		1	AO2 4.5.2.1
02.7	an answer in the range 0.373–0.495 (nanometres)		1	AO3 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	$3.04 \times 10^{-10} \text{ m}$		1	AO2 4.5.1.4
02.9	<p>batteries increased from 10 to 28 or batteries increased by 18</p> <p>producing ceramics and / or glass increased from 10 to 22 or producing ceramics and / or glass increased by 12</p> <p>lubricants decreased from 8 to 6 or lubricants decreased by 2</p>	<p>allow batteries increased approximately $\times 3$</p> <p>allow ceramics and / or glass increased by approximately $\times 2$</p> <p>allow lubricants decreased by a quarter</p> <p>if no other marks awarded allow 1 mark for batteries and glass / ceramics increased, lubricants decreased, with no or incorrect data</p>	<p>1</p> <p>1</p> <p>1</p>	AO2 4.5.1.4
Total			13	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	melting points decrease (as the atomic number increases)	allow negative correlation	1	AO2 4.5.1.4
02.2	55 and 29 (°C)	allow values in range 28–32 (°C)	1	AO2 4.5.1.4
02.3	1		1	AO2 4.5.1.1 4.5.1.4
02.4	<div> <div>Substance</div> <div> <div>Lithium oxide</div> <div>Oxygen</div> </div> <div> <div>Description</div> <div> <div>compound</div> <div>element</div> <div>metal</div> <div>mixture</div> <div>polymer</div> </div> </div> </div>		<div>1</div> <div>1</div>	<div>AO2 4.5.2.1</div> <div>AO1 4.5.2.1</div>
02.5	$4\text{Li} + \text{O}_2 \rightarrow 2\text{Li}_2\text{O}$	allow correct multiples	1	AO2 4.5.2.1
02.6	ionic		1	AO1 4.5.1.4 4.6.2.2
02.7	$(M_r) = (2 \times 7) + 16$ = 30	an answer of 30 scores 2 marks	<div>1</div> <div>1</div>	AO2 4.5.2.3
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7		1	AO1 4.1.2.6
02.2	small molecule		1	AO2 4.1.2.6 4.2.2.4
02.3	F ₂		1	AO1 4.1.1.1 4.1.2.6
02.4	the reactivity decreases (going down Group 7)	allow the reactivity decreases from chlorine to iodine	1	AO1 4.1.2.6
	(because) chlorine displaces bromine and iodine	allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine	1	AO3 4.1.2.6
	(and) bromine displaces iodine or iodine does not react	allow (and) bromine has one reaction or iodine has no reactions allow (and) iodine cannot displace bromine	1	AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(1.2 kg =) 1200 (g) or (900 g =) 0.9 (kg)	an answer of 75 (%) scores 2 marks	1	AO2 4.3.3.1
	$(\frac{900}{1200} \times 100) = 75(\%)$ or $(\frac{0.9}{1.2} \times 100) = 75(\%)$	allow an answer correctly calculated from: $(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$ or incorrect attempt at $(\frac{\text{conversion of 900}}{1.2} \times 100)$	1	
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	group 7		1	AO1 5.1.2.6
02.2		one shared pair anywhere in overlap between two circles or on intersection 6 other electrons on each atom allow dots or crosses or mixture for all marks ignore any inner shell electrons	1 1	AO2 5.1.2.6 5.2.1.4
02.3	bromine potassium chloride	allow correct chemical formulae either order	1 1	AO2 5.1.1.1 5.1.2.6
02.4	displacement		1	AO1 5.1.2.6
02.5	(an) electron		1	AO2 5.1.2.6
02.6	smaller than		1	AO2 5.1.2.1 5.1.2.6

02.7	(chlorine has) fewer levels / shells (of electrons)	mark independent of answer to question 02.6 allow converse for bromine allow (chlorine has) fewer electrons allow Cl has 3 levels / shells <u>and</u> Br has 4 levels / shells ignore atomic number or mass number or number of protons	1	AO2 5.1.2.1 5.1.2.6
02.8	3	allow multiples	1	AO2 5.1.1.1 5.1.2.6
02.9	there are <u>weak forces</u> between <u>molecules</u> which require little <u>energy</u> to overcome / break	do not accept weak bonds allow weak intermolecular forces for the first 2 marks allow does not need much <u>energy</u> to boil	1 1 1	AO1 5.1.2.6 5.2.2.4 AO1 5.1.2.6 5.2.2.4 AO2 5.1.2.6 5.2.2.4
Total			13	

Question	Answers	Extra information	Mark	AO / Spec.
03.1	atomic weight of element		1	AO1 5.1.2.2
03.2	gaps	allow spaces / blanks do not accept undiscovered elements	1	AO1 5.1.2.2
03.3	noble gases		1	AO1 5.1.2.4
03.4	18 22	this order only	1 1	AO2 5.1.1.5
03.5	isotopes		1	AO1 5.1.1.5
03.6	2,8,8		1	AO2 5.1.1.5
03.7	stable arrangement (of electrons)	allow full outer shell allow eight electrons in the outer shell allow does not need to gain or lose electrons	1	AO1 5.1.2.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$	allow multiples	1	AO1 5.1.2.2
04.2	7.1 (g)		1	AO2 5.3.1.1
04.3	silver	this order only	1	AO1 5.1.2.5
	green	allow yellow	1	
	yellow	allow white	1	
	white		1	
04.4	Na^+		1	AO1 5.2.1.2
	Cl^-	if no other mark awarded allow 1 mark for +(1) charge for sodium ion and -(1) charge for chloride ion	1	
04.5	an electron		1	AO2 5.1.2.5

04.6	potassium (atom) is <u>larger</u> potassium (atom) has more energy levels (of electrons) or potassium (atom) has more shells (of electrons)	allow converse for sodium mark independently	1	AO2 5.1.2.1 & 5.1.2.5
		do not accept more outer shells	1	
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	sodium oxide	allow Na ₂ O	1	AO2 4.1.1.1 4.1.2.5 4.4.1.1
07.2	oxidation		1	AO1 4.4.1.1
07.3	13		1	AO1 4.4.2.4
07.4	sodium hydroxide		1	AO2 4.1.1.1
07.5	OH ⁻		1	AO1 4.4.2.4
07.6	<p>(volume =) $\frac{250}{1000}$ or $\frac{1}{4}$ or 0.25 (dm³)</p> <p>or</p> <p>(mass per cm³ =) $\frac{40}{1000}$ (g) or 0.04 (g)</p> <p>($\frac{250}{1000} \times 40 =$) 10 (g)</p>	an answer of 10 (g) scores 2 marks	<p>1</p> <p>1</p>	AO2 4.3.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	all points correct	allow a tolerance of $\pm \frac{1}{2}$ a small square allow 1 mark for 3 points correct ignore any attempt at a line of best fit	2	AO2 4.1.2.5
07.8	39 (°C)	allow any value from 34 to 46 (°C)	1	AO2 4.1.2.5
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	FeS ₂	do not accept equations	1	AO2 4.2.1.3
09.2	26	must be this order	1	AO2 4.1.1.4 4.1.1.5
	30		1	
	26		1	
09.3	any two from: <ul style="list-style-type: none"> 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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) or (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons	1	
		allow (so) carbon transfers electrons to nickel (ions)		
09.5		an answer of 67.8 (%) scores 3 marks		AO2 4.3.3.2
		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		
	(total M_r of reactants =) 87		1	
	(percentage atom economy)	allow (percentage atom economy)	1	
	$= \frac{59}{87} \times 100$	$= \frac{59}{\text{incorrectly calculated } M_r} \times 100$		
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			11	

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any one from: <ul style="list-style-type: none"> so elements / iodine / tellurium were in groups with similar properties iodine has similar properties to Br / Cl / F / Group 7 iodine has different properties to Se / S / O / Group 6 	ignore reference to atomic structure ignore references to Cr, Mn and Mo allow corresponding argument in terms of tellurium	1	AO1 4.1.2.2
01.2	Mendeleev had predicted properties of missing elements elements were discovered (that filled the spaces / gaps) properties (of these elements) matched Mendeleev's predictions	ignore reference to atomic structure allow atomic weights (of these elements) fitted in the spaces / gaps if no other mark awarded, allow 1 mark for in previous versions of the periodic table the pattern of similar properties broke down	1 1 1	AO1 4.1.2.2
01.3	relative atomic mass		1	AO1 4.1.1.6
01.4	(increasing) atomic / proton number	ignore (increasing) electron number do not accept relative atomic / proton number	1	AO1 4.1.2.1
01.5	(formula) At ₂ (state) solid	ignore incorrect state symbol allow (s) ignore s	1 1	AO1 4.1.2.6

01.6	any two from: <ul style="list-style-type: none">• flame• (white) solid forms• colour of gas / chlorine disappears / fades	allow burns allow (white) smoke forms	2	AO1 4.1.2.5
Total			10	

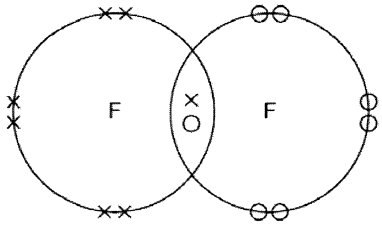
Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(neutron) 1 0	both needed allow (neutron) 1 neutral	1	AO1 4.1.1.4 4.1.1.5
	proton 1 (+1)	both needed	1	
04.2	number of protons plus neutrons	allow number of protons and neutrons ignore protons and neutrons unqualified do not accept references to mass or relative mass of protons and / or neutrons	1	AO1 4.1.1.5
04.3	(the isotopes contain) different numbers of neutrons		1	AO2 4.1.1.5
04.4	most (alpha) particles passed (straight) through (the gold foil)		1	AO1 4.1.1.3
	(so) the mass of the atom is concentrated in the nucleus / centre or (so) most of the atom is empty space		1	
	some (alpha) particles were deflected / reflected (so) the atom has a (positively) charged nucleus / centre	if not awarded for MP2, allow (so) the mass of the atom is concentrated in the nucleus / centre.	1	
Total			8	

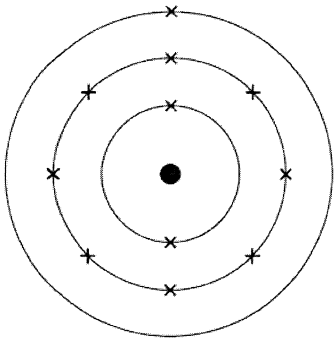
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	B		1	AO1 4.1.1.3
04.2	C		1	AO2 4.1.1.3
04.3	A		1	AO2 4.1.1.3
04.4	sum of protons and neutrons	allow number of protons and neutrons	1	AO1 4.1.1.5
04.5	between 69.5 and 70.0		1	AO2 4.1.1.6
04.6	Chadwick provided the evidence to show the existence of neutrons	allow Chadwick discovered neutrons	1	AO1 4.1.1.3
	(this was necessary because) isotopes have the same number of protons or (this was necessary because) isotopes are atoms of the same element	allow (this was necessary because) isotopes have the same atomic number ignore isotopes have the same number of electrons	1	AO3 4.1.1.5
	but with different numbers of neutrons	allow but with different mass (numbers)	1	AO1 4.1.1.5
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	atomic weight	do not accept atomic mass or A_r	1	AO1 5.1.2.2
04.2	left gaps / spaces or changed the order based on atomic weights	 allow placed them in correct groups according to properties do not accept reference to atomic number	1	AO1 5.1.2.2
04.3	weak forces between the molecules or weak intermolecular forces (so) little energy required to overcome / break the forces between molecules or (so) little energy required to overcome / break the intermolecular forces	allow weak intermolecular bonds do not accept incorrect references to covalent bonds allow (so) little energy required to separate the molecules allow (so) little energy required to overcome / break the intermolecular bonds ignore less energy	1 1	AO1 AO3 5.1.2.6 5.2.2.4

04.4	(the) molecules get larger going down the group	allow converse explanation in terms of boiling point	1	AO1 AO3 5.1.2.6 5.2.2.4
	(so the) forces <u>between the molecules</u> increase or (so the) intermolecular forces increase		1	
	(so the) boiling points increase going down the group or (so the) boiling points increase with increasing relative atomic mass	allow (so) more energy is needed to separate the molecules	1	
04.5	2,8	allow diagram or description	1	AO1 5.1.2.4
	(so) stable arrangement of electrons or (so) full outer shell		1	
04.6	$\frac{1}{40} \times 6.02 \times 10^{23}$ or $0.025 \times 6.02 \times 10^{23}$	an answer of 1.51×10^{22} scores 2 marks	1	AO2 5.3.2.1
	1.51×10^{22}	allow 1.505×10^{22}	1	
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	g	do not accept upper case (G) do not accept gas	1	AO1 5.1.2.6
04.2		one shared pair anywhere in overlap between two circles or on intersection 6 other electrons on each atom allow dots or crosses or mixture for all marks ignore any inner shell electrons	1 1	AO1 5.1.2.6 5.2.1.4 AO2 5.1.2.6 5.2.1.4
04.3	18		1	AO2 5.1.1.5 5.1.2.6
04.4	AlBr_3 $2 \text{ Al} + 3 \text{ Br}_2 \rightarrow 2 \text{ AlBr}_3$	ignore state symbols ignore charges ignore brackets as eg $\text{Al}(\text{Br})_3$ allow 1 mark for balancing their equation with an incorrect product	1 1	AO2 5.1.1.1 5.1.2.6

04.5	<p>chlorine is a smaller atom or has fewer energy levels or outer shell closer to nucleus</p> <p>chlorine has less shielding or has the greater attraction between the nucleus and the outer shell or incoming electron</p> <p>therefore chlorine can gain an electron (into the outer shell) more easily</p>	<p>max 2 if outer shell / level not mentioned 'it' refers to chlorine allow converse reasons for bromine being less reactive</p> <p>ignore chlorine has fewer electrons</p> <p>if no other marks awarded allow 1 mark for correct trend in reactivity in Group 7</p> <p>do not accept reference to incorrect particles eg chloride atom</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO1 5.1.2.6</p> <p>AO1 5.1.2.6</p> <p>AO2 5.1.2.6</p>
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1		allow dot, cross, or e to show electrons	1	AO1 4.5.1.1
04.2	any two from: <ul style="list-style-type: none"> • use tongs / tweezers to handle metal • use a (safety) screen • use a small piece of metal • use a large volume of water • keep a safe distance between teacher / students and apparatus 	ignore store metal under oil	2	AO3 4.5.1.4
04.3	OH ⁻		1	AO1 4.5.1.4 4.7.3.4
04.4	as diameter increases, reactivity increases (because as diameter increases) outer electron is further from the nucleus (so) outer electron is less attracted to the nucleus (so) outer electron is lost (more) easily	allow (because as diameter increases) outer shell is further from nucleus allow (so there is) increased shielding	1 1 1 1	AO3 4.5.1.4 AO1 4.5.1.4 AO1 4.5.1.4 AO1 4.5.1.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$		1	AO2 5.1.1.1 5.1.2.5
06.2	(before) silver solid / liquid / metal or green (gas)	allow grey solid / metal allow yellow (gas)	1	AO1 5.1.2.5
	(during) yellow flame or white smoke or green colour fades / disappears	allow orange / white flame allow vigorous reaction	1	
	(after) white solid / powder		1	

06.3	<p>(sodium has) fewer energy levels / shells</p> <p><u>outer</u> electron / shell is closer to nucleus or <u>outer</u> electron / shell is less shielded</p> <p>(so) greater attraction between nucleus and outer electron / shell</p> <p>(so) outer electron is less easily lost</p>	<p>allow converse for potassium</p> <p>allow diagrams of electron structure</p> <p>allow (so) loses an / one electron less easily allow (so) more energy needed to remove an / one electron</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO1 5.1.2.5</p>
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Question	Answers	Mark	AO/ Spec. Ref
06.4	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 AO2
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	

Indicative content		
	sodium chloride	hydrogen chloride
differences in bonding	ionic	covalent
	metal & non-metal	two non-metals
	transferring electrons	sharing electrons
	ions (Na^+ and Cl^-)	molecules
	charged particles	neutral or no overall charge
differences in structure	giant structure or lattice	small / simple / discrete molecules
	electrostatic	intermolecular forces
	(electrostatic forces) are strong	(intermolecular forces) are weak
	act in all directions	random or between the molecules
	regular	irregular / random
similarities in bonding	full shells or stability	full shells or stability
	(transferring) electrons	(sharing) electrons
	strong bonds	strong (covalent) bonds
similarities in structure	(electrostatic) forces	(intermolecular) forces
ignore properties eg melting points, conduct electricity		
to access level 2 there must be a comparison of the structure and bonding and magnitude of both sodium chloride and hydrogen chloride.		

Total			14
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	chlorine is toxic	allow carbon monoxide is toxic allow poisonous for toxic ignore harmful / deadly / dangerous allow a poisonous gas is used / produced allow titanium chloride is corrosive	1	AO3 4.1.2.6 4.4.1.3
08.2	any one from: <ul style="list-style-type: none"> very exothermic reaction produces a corrosive solution produces hydrogen, which is explosive / flammable 	allow explosive allow violent reaction ignore vigorous reaction ignore sodium is very reactive allow caustic for corrosive ignore alkaline allow flames produced ignore sodium burns	1	AO3 4.1.2.5 4.4.1.3
08.3	argon is unreactive / inert oxygen (from air) would react with sodium / titanium or water vapour (from air) would react with sodium / titanium	allow argon will not react (with reactants / products / elements) allow elements / reactants / products for sodium / titanium	1 1	AO3 4.1.2.4 4.1.2.5 4.4.1.1 4.4.1.3

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

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

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