

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	(difference) sodium has one and chlorine has seven electrons in <u>outer</u> level / shell or number of electrons	number of electrons must be correct if quoted	1	AO2 5.1.1.7 5.1.2.1
	(similarity) both have three / same number of levels / shells or have electrons in third level / shell or both have incomplete (outer) levels / shells	allow both have 2 electrons in inner shell or both have 8 electrons in second shell or both are one electron away from full outer level / shell	1	

1.2		allow marks from suitable diagram(s)		
	sodium (atom) loses	allow moves / transfers for loses do not accept sodium ion loses	1	AO1 5.2.1.2
	one (outer shell electron)		1	AO2 5.2.1.2
	chlorine (atom) gains	do not accept chloride	1	AO1 5.2.1.2
	one (electron)	transfer of 1 electron from chlorine to sodium max 2 marks reference to sharing or covalent bonding max 3 marks	1	AO2 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	g	do not accept upper case (G) do not accept gas	1	AO1 5.1.2.6

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

3.1	any two from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	potassium chloride and iodine	either order allow KCl for potassium chloride and I ₂ for iodine	1	AO1 4.1.2.6

4.2		allow converse statements allow energy levels for shells throughout		AO1 4.1.2.6
	(chlorine's) outer electrons / shell closer to the nucleus	allow chlorine has fewer shells allow chlorine atom is smaller than iodine atom ignore chlorine has fewer outer shells	1	
	(so) the chlorine nucleus has greater attraction for outer electrons / shell	allow chlorine has less shielding do not accept incorrect types of attraction	1	
	(so) chlorine gains an electron more easily	maxf 2 marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine	1	

5.1	any one from: • very exothermic reaction • produces a corrosive solution • produces hydrogen, which is explosive / flammable	allow explosive allow violent reaction ignore vigorous reaction ignore sodium is very reactive allow caustic for corrosive ignore alkaline allow flames produced ignore sodium burns	1	AO3 4.1.2.5 4.4.1.3

5.2	argon is unreactive / inert	allow argon will not react (with reactants / products / elements)	1	AO1
	oxygen (from air) would react with sodium / titanium or water vapour (from air) would react with sodium / titanium	allow elements / reactants / products for sodium / titanium	1	AO3 4.1.2.4 4.1.2.5 4.4.1.1 4.4.1.3

6.1	transition metals		1	AO2 4.1.3.2
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7.1	(beryllium is) less reactive any one from: • greater attraction between nucleus and outer electrons • more energy is needed to remove electrons • loss of electrons is more difficult • outer electrons closer to nucleus • less shielding	allow converse answers for magnesium MP2 only if MP1 is correct allow higher in <u>group</u> allow reactivity increases down the <u>group</u> ignore reactivity series	1 1	AO3 5.1.2.3 5.1.2.5 5.4.1.2
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	atomic weight	do not accept atomic mass or A_r	1	AO1 5.1.2.2

8.2	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

8.3	2,8 (so) stable arrangement of electrons or (so) full outer shell	allow diagram or description	1 1	AO1 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	$2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$		1	AO2 5.1.1.1 5.1.2.5

9.2	(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	

9.3		allow converse for potassium		AO1 5.1.2.5
	(sodium has) fewer energy levels / shells	allow diagrams of electron structure	1	
	<u>outer</u> electron / shell is closer to nucleus or <u>outer</u> electron / shell is less shielded		1	
	(so) greater attraction between nucleus and outer electron / shell		1	
	(so) outer electron is less easily lost	allow (so) loses an / one electron less easily allow (so) more energy needed to remove an / one electron	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	• 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	allow corresponding argument in terms of tellurium		
	Mendeleev had predicted properties of missing elements elements were discovered (that filled the spaces / gaps)	ignore reference to atomic structure	1 1	AO1 4.1.2.2

10.2	properties (of these elements) matched Mendeleev's predictions	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	

10.3	relative atomic mass		1	AO1 4.1.1.6
	(increasing) atomic / proton	ignore (increasing) electron	1	AO1

10.4	number	number do not accept relative atomic / proton number		4.1.2.1
	(formula) At ₂	ignore incorrect state symbol	1	AO1 1 1 2 6

10.5	(state) solid	allow (s) ignore s	1	4.1.2.0
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10.6	• (white) solid forms • colour of gas / chlorine disappears / fades	allow (white) smoke forms		
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11.1	Cr_2O_3		1	AO2 4.1.3.2
	(for bonds broken)	an answer of (-)1272 (kJ) scores 3 marks		AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	caesium atom loses one electron (and) oxygen atom gains two electrons (so) two caesium atoms react with one oxygen atom any one from: • (to form) Cs^+ and O^{2-} • (to form) caesium ion(s) and oxide ion(s) • (to form) ions with full outer shells / levels	max 3 marks if reference to incorrect particles / bonding / structure allow (to produce) Cs_2O	1 1 1 1	AO1 5.1.2.5 5.2.1.2

12.2	(caesium has) more energy levels or (caesium has) more shells	allow converse for sodium	1	AO2
	(so the) outer electron / shell is further from nucleus or outer electron / shell is more shielded		1	AO1
	(so) weaker attraction between nucleus and outer electron / shell		1	AO1
	(so) outer electron is more easily lost	allow (so) less energy needed to remove outer electron	1	AO1 5.1.2.3 5.1.2.5

12.3	early periodic tables were arranged with elements in order of their atomic weights	ignore atomic mass	1	AO1
	iodine has a lower atomic weight than tellurium	allow converse for tellurium	1	AO1
	(so) Mendeleev placed iodine with elements with same / similar properties	allow F / Cl / Br for elements	1	AO2
	or (so) Mendeleev placed tellurium with elements with same / similar properties	allow O / S / Se for elements		5.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.1	they form ions with different charges		1	AO1 4.1.3.1 4.1.3.2
	they have high melting points		1	

14.1	atomic number is the number of protons		1	AO3 4.1.1.3 4.1.1.4
	(and) protons were not discovered until later	ignore electrons / neutrons were not discovered until later	1	4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14.2	so their properties matched the rest of the group	allow converse	1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
15.1	liquid gas		1	AO2 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
15.2	(going down the group) the outer electrons / shell become further from the nucleus (so) the nucleus has less attraction for the outer electrons / shell (so) an electron is gained less easily	allow energy level for shell throughout allow the atoms become larger allow the number of shells increases ignore the number of outer shells increases allow (so) the nucleus has less attraction for the incoming electron allow (so) increased shielding between the nucleus and the outer electrons / shell allow (so) increased shielding between the nucleus and the incoming electron	1 1 1	AO1 4.1.2.6

16.1	Co ²⁺		1	AO2 4.1.3.2 4.6.2.5
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
17.1	(Group) 0 or noble gases		1	AO2 5.1.2.2

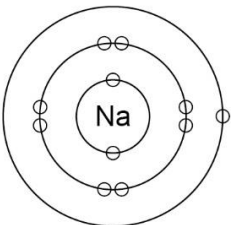
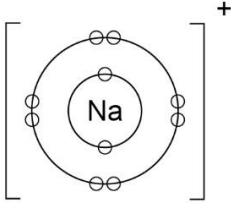
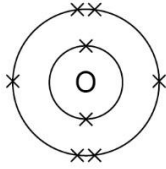
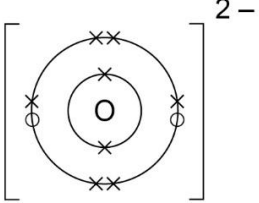
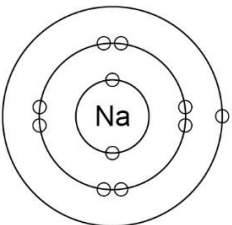
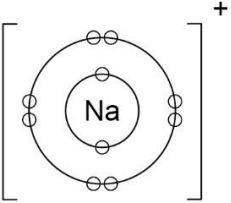
Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.1	Ga^{3+}		1	AO3 4.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
18.2	(gallium) fitted in a gap (Mendeleev had left)		1	AO2 4.1.2.2
	(gallium's) properties were predicted correctly (by Mendeleev)	allow (gallium's) properties matched the rest of the group	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.1	any two from: • (potassium) floats • (potassium) melts • (potassium) moves around • potassium becomes smaller • (lilac) flame • effervescence	allow potassium disappears allow fizzing	2	AO1 4.1.2.5 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.2	$2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$	allow multiples allow 1 mark for KOH and H ₂	2	AO1 AO2 4.1.1.1 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.3	reactivity increases (going down the group)		1	AO1 4.1.2.5 4.4.1.2
	(because) the outer electron / shell is further from the nucleus	allow (because) there are more shells allow (because) the atoms get larger	1	
	(so) there is less attraction between the nucleus and the outer electron / shell	allow (so) there is more shielding from the nucleus do not accept incorrect attractions	1	
	(so) the atom loses an electron more easily		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
19.4	(dot and cross diagram to show) sodium atom and oxygen atom two sodium atoms to one oxygen atom (to produce) sodium ion with a + charge (to produce) oxide ion with a 2- charge	allow use of outer shells only allow two sodium ions to one oxide ion	1 1 1 1	AO2 4.2.1.1 4.2.1.2
	 	 	 	scores 4 marks

Question	Answers	Extra information	Mark	AO / Spec. Ref.
20.1	halogens		1	AO1 5.1.2.6

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
20.2	all have 7 electrons in <u>outer</u> shell or all have 7 <u>outer</u> electrons	allow energy level for shell allow same number of <u>outer</u> electrons allow one electron required to complete the <u>outer</u> shell	1	AO1 5.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
20.3	y-axis scale correct from –100 to –250 °C		1	AO2 5.1.2.6
	bar correctly plotted at –220 °C	allow a tolerance of $\pm \frac{1}{2}$ a small square	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
20.4	(the) molecules increase in size going down the group (so the) forces between the molecules increase or (so the) intermolecular forces increase (so the) melting points increase going down the group or (so the) melting points increase with increasing relative atomic mass	allow converse explanation in terms of decreasing melting point allow atoms increase in size going down the group allow increase in number of electron shells going down group allow (so) more energy is needed to separate the molecules	1 1 1	AO3 AO1 AO1 5.1.2.6 5.2.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
20.5	(s)		1	AO3 5.1.2.6 5.2.2.1 5.2.2.2

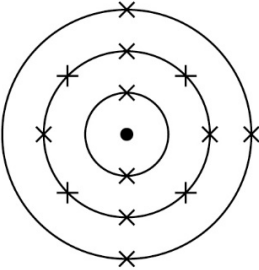
Question	Answers	Extra information	Mark	AO / Spec. Ref.
21.1	D		1	AO3 4.1.2.3

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
21.2	B		1	AO3 4.1.3.2

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
21.3	any two from: (Group 1 elements) • have lower melting / boiling points • have lower densities • are less strong • are softer	transition elements allow (Group 1 elements are) more malleable / ductile allow (Group 1 elements) are not useful as catalysts ignore transition elements form coloured compounds ignore transition elements form ions with different charges ignore references to chemical properties	2	AO1 4.1.3.1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
21.4		allow any combination of x, •, o, e ⁽⁻⁾ for electrons	1	AO2 4.1.1.7

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

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
22.3	$2 \text{ Rb} + 2 \text{ H}_2\text{O} \rightarrow 2 \text{ RbOH} + \text{H}_2$	allow multiples allow 1 mark for H_2 allow 1 mark for RbOH	3	AO2 4.1.1.1 4.1.2.5 4.3.1.1

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

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
23.1	$4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$	allow multiples	1	AO2 5.1.1.1 5.1.2.5 5.3.1.1 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
23.2	sodium atom loses one electron		1	AO1 5.1.1.7
	(and) oxygen atom gains two electrons		1	5.1.2.3 5.1.2.5
	(so) two sodium atoms to one oxygen atom		1	5.2.1.2
	any one from: • (to form) Na^+ and O^{2-} • (to form) sodium ion(s) and oxide ion(s) • (to form) ions with full outer shells / levels.		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
23.3	yellow flame any one from: • sodium melts • white smoke / solid / powder	allow orange flame	1 1	AO1 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
23.4	(potassium) (burns with a) lilac flame	allow (burns with a) different colour flame	1	AO1 5.1.2.5
	burns faster	allow more vigorous reaction	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
24.1	36		1	AO2 5.1.1.4 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
25.1	(number of outer shell electrons) 7		1	AO2 4.1.2.1 4.1.2.6
	(reason) (tennessine is in) Group 7	allow the number of outer electrons is the same as the group number allow tennessine is a halogen MP2 is dependent on MP1 being awarded	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
25.2	(time needed for) peer review	allow the idea that other scientists had to check the results	1	AO3 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
26.1	argon / Ar		1	AO2 4.1.2.4 4.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
27.1	(atoms of) argon have a stable arrangement of electrons	allow (atoms of) argon have a full outer shell (of electrons)	1	AO1 4.1.2.3 4.1.2.4 4.2.1.1
	(so) argon (atoms) do not share / transfer electrons		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
27.2	PH ₃	allow H ₃ P	1	AO2 4.1.2.1 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
27.3	yes, because tellurium is towards the right of the periodic table (so) tellurium is a non-metal OR yes, because tellurium is in the same group as oxygen / sulfur (1) (and) oxygen / sulfur will react with metals (1) OR no, because tellurium is towards the bottom of the periodic table (1) (so) tellurium is a metal (1) OR cannot predict as tellurium is towards the bottom and to the right of the periodic table (1) (so) don't know whether tellurium is a metal or non-metal (1)	MP2 is dependent upon MP1 being awarded allow yes, because tellurium is in Group 6 allow (so) tellurium will gain electrons (from a metal) allow (so) tellurium is a non-metal allow (so) tellurium will gain electrons (from a metal) allow (so) difficult for tellurium to gain electrons (from a metal) (1) allow (so) don't know whether tellurium will gain electrons	1 1	AO3 4.1.2.3