

Answer **all** the questions.

1(a). Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

Complete the table.

[4]

(b). Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

[2]

(c). Particle **C** has the electronic structure 2.8.7.

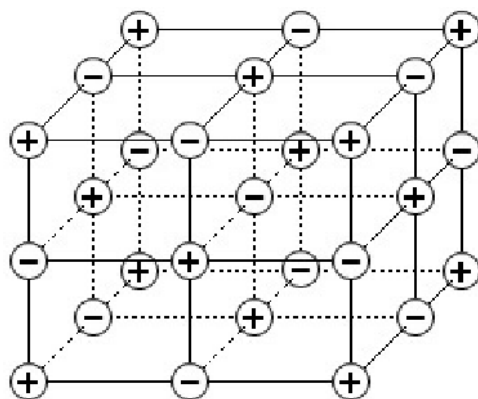
What does this tell you about the position of particle **C** in the Periodic Table?

Explain your answer.

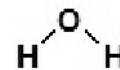
[4]

2. Look at the diagrams.

They show the structures of two compounds.



sodium chloride



water

Magnesium oxide has a similar structure to sodium chloride.

Draw 'dot and cross' diagrams to show the ionic bonding in magnesium oxide.

You should include the charges on the ions.

The electronic structure of magnesium is 2.8.2.

The electronic structure of oxygen is 2.6.

[3]

3. Lead is a metal.

Which statement is true about lead **because** it is a metal?

- A It is a dull grey colour.
- B It is in Group 4 of the Periodic Table.
- C It is in Period 6 of the Periodic Table.
- D It is malleable so can be easily shaped.

Your answer

[1]

4(a). Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	-----	11	2.8.1
B	9	19	9	10	9	-----
C	-----	37	17	-----	17	2.8.7
D	13	27	-----	-----	10	2.8

Complete the table.

[4]

(b). Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

[2]

(c). Element **C** has the electronic structure 2.8.7.

What does this tell you about the position of element **C** in the periodic table?

Explain your answer.

[4]

5(a). This question is about the Periodic Table.

Look at the list of elements.

aluminium

boron

bromine

helium

potassium

silver

Answer these questions.

Use the Periodic Table on the back page to help you.

Choose your answers from the list.

(i) Two elements are in the same **group** of the Periodic Table.

Which two elements?

----- and ----- [1]

(ii) Two elements are in the same **period** of the Periodic Table.

Which two elements?

----- and ----- [1]

(iii) Write down the name of a **transition** element.

----- [1]

(b). One scientist who helped to develop the Periodic Table was called Mendeleev.

Write about how Mendeleev helped in the development of the Periodic Table.

[2]

6. Fluorine reacts with chlorine to make a compound called chlorine fluoride, ClF .

ClF is a **covalent** compound.

The electronic structure of chlorine is 2.8.7.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the covalent bonding in chlorine fluoride.

[2]

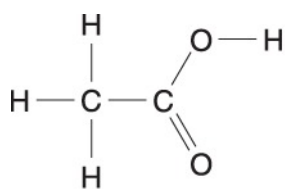
7. One scientist who helped to develop the Periodic Table was called Mendeleev.

Write about how Mendeleev helped in the development of the Periodic Table.

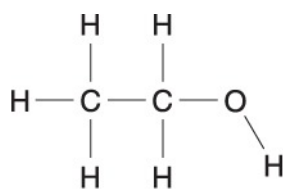
[2]

8. This question is about carbon compounds.

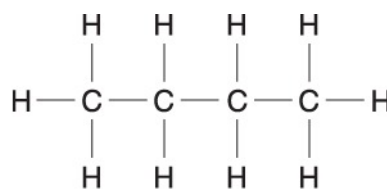
Look at the displayed formulas of some compounds.



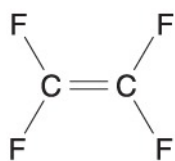
A



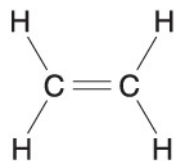
B



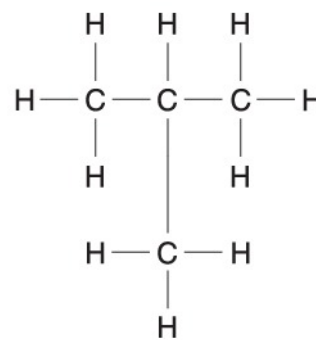
C



D



E



F

Compound **D** is called tetrafluoroethene.

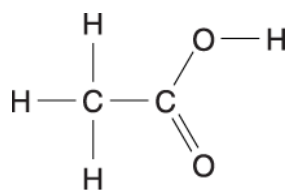
It is a monomer and can be made into a polymer.

What is the name of this polymer?

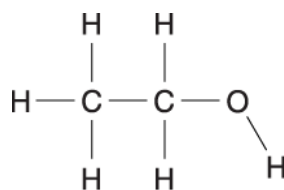
-----[1]

9. This question is about carbon compounds.

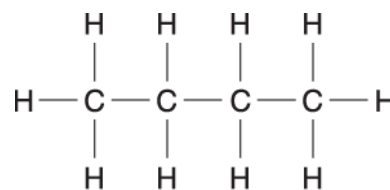
Look at the displayed formulas of some compounds.



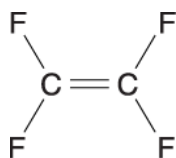
A



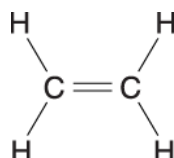
B



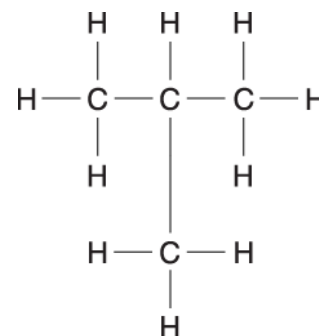
C



D



E



F

Compound **D** is a monomer and makes an addition polymer.

Draw the **displayed** formula for this polymer.

[1]

10. Look at these symbols and formulas.



(i) Which formula is a **molecule**?

answer

[1]

(ii) Which formula is an **ion**?

answer

[1]

11(a). Ammonia has the formula, **NH₃**.

The electronic structure of nitrogen is 2.5.

The electronic structure of hydrogen is 1.

Draw a 'dot and cross' diagram to show the **covalent** bonding in ammonia.

Show all the electrons.

[2]

(b). Sodium chloride is an **ionic** compound.

Sodium chloride

- will not conduct electricity when it is a solid
- will conduct electricity when it is dissolved in water.

Explain these two observations in terms of structure and bonding.

[2]

12. Describe **metallic bonding** and explain why metals are good conductors of electricity.

You may wish to draw a labelled diagram.

[3]

13. Look at the table. It shows information about the Group 1 metals.

Element	Symbol	Electronic structure	Melting point in °C	Boiling point in °C	Atomic radius in nm
lithium	Li	2.1	181	1342	0.152
sodium	Na	2.8.1	-----	883	0.185
potassium	K	2.8.8.1	64	760	0.227
rubidium	Rb	2.8.18.8.1	39	688	-----

Sodium reacts with fluorine. Sodium ions and fluoride ions are made.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the electronic structure of a sodium ion and of a fluoride ion. Include the charges on the ions.

[2]

14. Describe, using a labelled diagram, what is meant by metallic bonding.

[2]

15(a). This question is about magnesium, Mg.

Use the Periodic Table to help you answer these questions.

Write down the name of an element in the same **group** as magnesium.

[1]

(b). Write down the name of an element in the same **period** as magnesium.

[1]

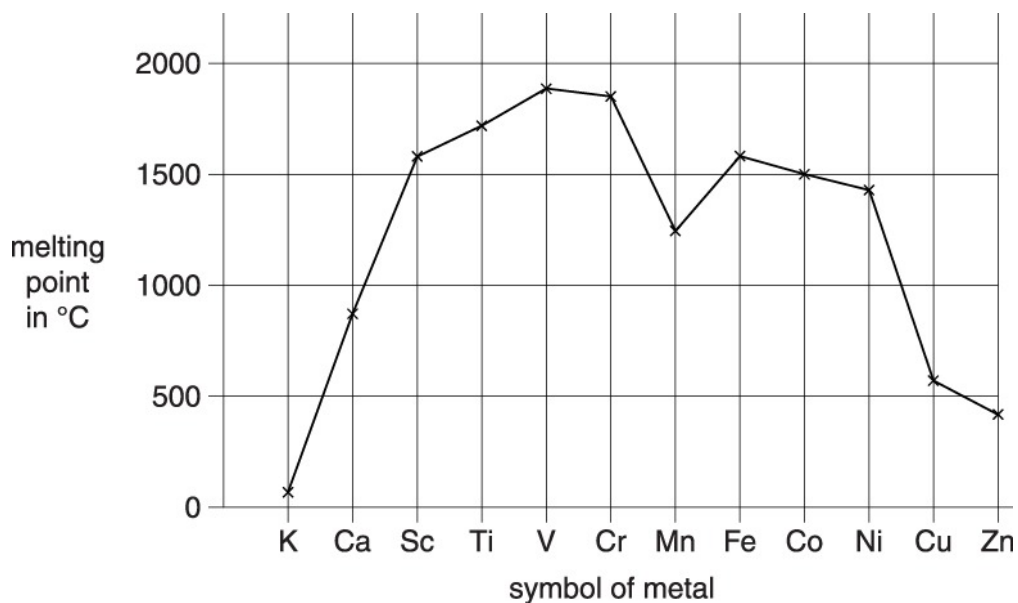
(c). The electronic structure of magnesium is 2.8.2.

What does this tell you about the **group** and the **period** that magnesium is in?

[2]

16(a). Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.



Write the **symbol** of the metal which has the **weakest** metallic bonds.

----- [1]

(b). One property of metals is that they often have high melting points.

Write about **other** properties of metals.

----- [2]

17(a). The table shows the electronic structures of the atoms of some elements.

Element	Symbol	Electronic structure
helium	He	2
oxygen	O	2.6
neon	Ne	2.8
magnesium	Mg	2.8.2
chlorine	Cl	2.8.7
calcium	Ca	2.8.8.2

Write down the symbols for two elements in the same **group** of the periodic table.

Choose from the table above.

_____ and _____

[1]

(b). Write down the symbols for two elements in the same **period** of the periodic table.

Choose from the table above.

_____ and _____

[1]

18. Most metals have these physical properties.

shiny

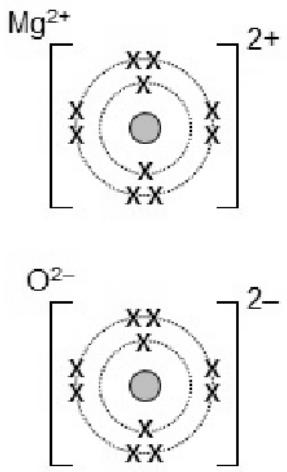
high melting point

high boiling point

Write down **two** other physical properties that most metals have.

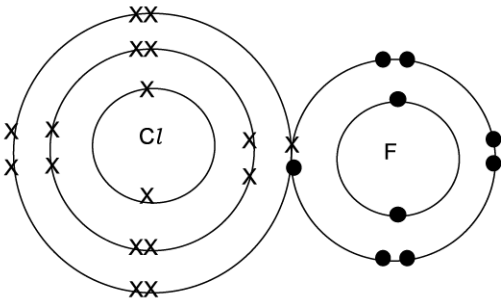
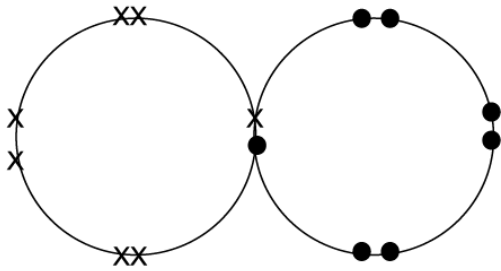
[2]

END OF QUESTION PAPER

Question		Answer/Indicative content					Marks	Guidance																																			
1	a	<table border="1"> <thead> <tr> <th>Particle</th> <th>Atomic number</th> <th>Mass number</th> <th>Number of protons</th> <th>Number of neutrons</th> <th>Number of electrons</th> <th>Electronic structure</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>11</td> <td>23</td> <td>11</td> <td>12</td> <td>11</td> <td>2.8.1</td> </tr> <tr> <td>B</td> <td>9</td> <td>19</td> <td>9</td> <td>10</td> <td>9</td> <td>2.7</td> </tr> <tr> <td>C</td> <td>17</td> <td>37</td> <td>17</td> <td>20</td> <td>17</td> <td>2.8.7</td> </tr> <tr> <td>D</td> <td>13</td> <td>27</td> <td>13</td> <td>14</td> <td>10</td> <td>2.8</td> </tr> </tbody> </table>					Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure	A	11	23	11	12	11	2.8.1	B	9	19	9	10	9	2.7	C	17	37	17	20	17	2.8.7	D	13	27	13	14	10	2.8	4	one mark scored for each correct line
Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure																																					
A	11	23	11	12	11	2.8.1																																					
B	9	19	9	10	9	2.7																																					
C	17	37	17	20	17	2.8.7																																					
D	13	27	13	14	10	2.8																																					
	b	particle A – one electron in outer shell or energy level (1) particle D – has more protons than electrons (1)					2																																				
	c	group 7 (1) as 7 electrons in outer shell (1) period 3 (1) as 3 shells occupied (1)					4																																				
		Total					10																																				
2		 <p>electronic structure of magnesium ion (1) electronic structure of oxide ion (1) charges correct on both ions (1)</p>					3																																				
		Total					3																																				
3		D					1																																				
		Total					1																																				
4	a	<table border="1"> <thead> <tr> <th>Particle</th> <th>Atomic number</th> <th>Mass number</th> <th>Number of protons</th> <th>Number of neutrons</th> <th>Number of electrons</th> <th>Electronic structure</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>11</td> <td>23</td> <td>11</td> <td>12</td> <td>11</td> <td>2.8.1</td> </tr> <tr> <td>B</td> <td>9</td> <td>19</td> <td>9</td> <td>10</td> <td>9</td> <td>2.7</td> </tr> <tr> <td>C</td> <td>17</td> <td>37</td> <td>17</td> <td>20</td> <td>17</td> <td>2.8.7</td> </tr> <tr> <td>D</td> <td>13</td> <td>27</td> <td>13</td> <td>14</td> <td>10</td> <td>2.8</td> </tr> </tbody> </table>					Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure	A	11	23	11	12	11	2.8.1	B	9	19	9	10	9	2.7	C	17	37	17	20	17	2.8.7	D	13	27	13	14	10	2.8	4	one mark scored for each correct line
Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure																																					
A	11	23	11	12	11	2.8.1																																					
B	9	19	9	10	9	2.7																																					
C	17	37	17	20	17	2.8.7																																					
D	13	27	13	14	10	2.8																																					
	b	particle A – one electron in outer shell or energy level (1) particle D – has more protons than electrons (1)					2																																				

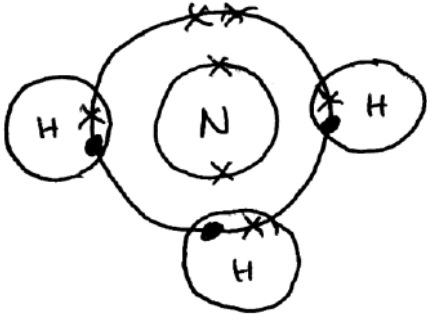
Question		Answer/Indicative content	Marks	Guidance
	c	group 7 (1) as 7 electrons in outer shell (1) period 3 (1) as 3 shells occupied (1)	4	
		Total	8	

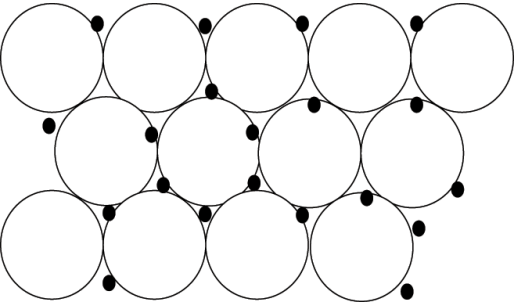
Question			Answer/Indicative content	Marks	Guidance
5	a	i	aluminium and boron (1)	1	<p>both required allow Al and B (1)</p> <p>Examiner's Comments</p> <p>Helium was a common misconception.</p>
		ii	potassium and bromine (1)	1	<p>both required allow K and Br (1)</p> <p>Examiner's Comments</p> <p>Helium was a common misconception.</p>
		iii	silver (1)	1	<p>allow Ag (1)</p> <p>Examiner's Comments</p> <p>A significant proportion of candidates did not gain credit as they wrote down the name of a transition metal, other than silver, thus failing to choose their answer from the list in the question.</p>
	b		<p>any two from:</p> <p>arranged elements in order of atomic mass (1)</p> <p>left gaps for elements not yet discovered (1)</p> <p>predicted properties of elements (1)</p> <p>arranged elements in periods (1)</p> <p>arranged elements in groups (1)</p>	2	<p>allow predicted properties of 'missing' elements for (2)</p> <p>allow arranged elements together with similar chemical properties (1)</p> <p>Examiner's Comments</p> <p>Good responses usually described how Mendeleev arranged elements in periods and groups. Many candidates, however, were unable to recall Mendeleev's work.</p>
			Total	5	

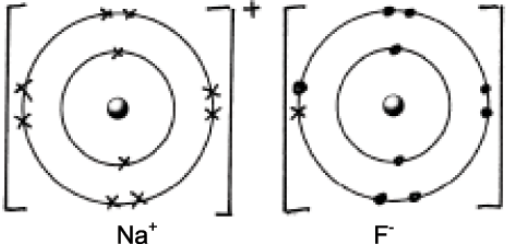
Question	Answer/Indicative content	Marks	Guidance
6	<p>all correct (2)</p> 	2	<p>allow one mark for bonding pair if the answer is incorrect</p> <p>allow diagrams using all dots or all crosses circles need not be drawn</p> <p>allow answer with outer shell electrons only i.e.</p>  <p>If inner shells shown they must be correct</p> <p>ignore any atomic symbol given in answer – just focus on the electrons</p> <p>ionic structure = 0 marks for the question</p> <p>Examiner's Comments</p> <p>This question was about chlorine and fluorine.</p> <p>Many candidates could draw the 'dot and cross' diagram for chlorine fluoride. A significant proportion of the candidates drew the inner shell electrons even though this was not needed in the answer. Some candidates neglected to include the symbol for each element and this type of answer was given full credit. Only a very small proportion of the candidates attempted an ionic 'dot and cross' diagram.</p>
	Total	2	

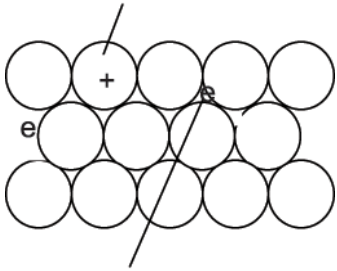
Question		Answer/Indicative content	Marks	Guidance
7		<p>any two from: arranged elements in order of (relative) atomic mass (1)</p> <p>left gaps in his table (for elements not yet discovered) (1)</p> <p>predicted properties of elements (1)</p> <p>arranged elements in periods (1)</p> <p>arranged elements in groups (1)</p> <p>realised that there was a periodic behaviour in the properties of the elements (1)</p>	2	<p>ignore reference to atomic number ignore reference to mass number</p> <p>allow predicted properties of 'missing' elements for two marks</p> <p>allow arranged elements together with similar chemical properties</p> <p>Examiner's Comments</p> <p>This question was about chlorine and fluorine.</p> <p>Many candidates gave good answers about the Periodic table in terms of atomic number and outer shell electrons but did not realise that these were not discovered until much later than Mendeleev's Periodic Table. The best answers referred to grouping according to chemical properties and the gaps in the table that Mendeleev left for elements still to be discovered. A significant proportion of the candidates confused Mendeleev's work with that of Newlands.</p>
		Total	2	
8		poly(tetrafluoroethene) (1)	1	<p>allow name without brackets</p> <p>allow Teflon / ptfe</p> <p>Examiner's Comments</p> <p>This question was about the displayed formulae of some carbon compounds.</p> <p>Some candidates gave the correct name of the polymer although poly(ethene) was a common incorrect answer.</p>
		Total	1	

Question		Answer/Indicative content	Marks	Guidance
9		<div style="text-align: center;"> <p>(1)</p> </div>	1	<p>structure must have the free bonds at both ends</p> <p>allow with or without brackets</p> <p>allow with or without n</p> <p>allow two or more repeat units, but must be an even number of C atoms (1)</p> <p>Examiner's Comments</p> <p>This question was about some of the hydrocarbons found in crude oil.</p> <p>Many candidates drew the correct formula for the polymer. Common errors included the use of C=C or not showing the free bonds. A minority of candidates included hydrogen atoms in the formula instead of fluorine atoms.</p>
		Total	1	
10	i	H ₂ O (1)	1	<p>Examiner's Comments</p> <p>Both parts of this question were well answered. A number of candidates offered 'N'.</p>
	ii	Na ⁺ (1)	1	<p>not NA⁺</p> <p>not Na</p>
		Total	2	

Question		Answer/Indicative content	Marks	Guidance
11	a	<p>At least one pair of electrons shared correctly between nitrogen and hydrogen (1)</p> <p>remainder of structure correct (1)</p> 	2	<p>can use all dots or all crosses</p> <p>not ionic structures = 0 for the question</p> <p>allow Lewis diagrams i.e. without circles</p> <p>allow lone pair electrons as two single electrons</p> <p>ignore inner electrons on nitrogen</p> <p>Examiner's Comments</p> <p>There were many examples of correct 'dot and cross' diagrams for ammonia. Candidates did not need to show the lone pair as electrons next to one another. The most common misconception involved having more than two non-bonding electrons in the outer shell of nitrogen or including an extra electron in the outer shell of hydrogen. Only a small proportion of the candidates drew ionic 'dot and cross' diagrams.</p>
	b	<p>solid – ions not free / ions cannot move / ions held in a lattice / ions in a giant structure (1)</p> <p>dissolved in water – ions can move (1)</p>	2	<p>ignore electrons / particles cannot move in a solid</p> <p>allow has free ions</p> <p>not electrons can move in a liquid</p> <p>ignore particles can move in a liquid</p> <p>?Examiner's Comments ??</p> <p>Many candidates referred to electrons rather than ions in their answer to this question. Good answers appreciated that ions did not move in the solid but would move in the aqueous solution.</p>
		Total	4	

Question	Answer/Indicative content	Marks	Guidance
12	<p>idea of (close packed) positive metal ions (1)</p> <p>idea electrons interspersed within the particles drawn / sea of electrons / delocalised electrons (1)</p> <p>electrons can move / free electrons / electrons can carry the current (1)</p>	3	 <p>Large circle labelled positive ion / metal ion / cation Small circle labelled electron / e / e⁻ but just a negative sign is not sufficient Mention of intermolecular forces / covalent bonds / ionic bonds can only score the electrons can move mark</p> <p>Examiner's Comments</p> <p>Many candidates illustrated their answers using a diagram, but often the diagram was not labelled so it was not possible to tell if the positive particle was a metal ion or a proton. Good diagrams were fully labelled and showed electrons interspersed between closely packed positive ions. The idea that the electrons could move resulting in electrical conductivity was well known.</p>
	Total	3	

Question	Answer/Indicative content	Marks	Guidance
13	 <p data-bbox="304 524 624 555">correct sodium ion / 2.8 (1)</p> <p data-bbox="304 591 624 622">correct fluoride ion / 2.8 (1)</p>	2	<p data-bbox="991 241 1453 304">two correct electronic structures but no charges award one mark</p> <p data-bbox="991 340 1422 403">two correct charges with incorrect electronic structure award one mark</p> <p data-bbox="991 439 1485 537">one structure of 2,8 but unlabelled is not sufficient but allow both have a structure of 2,8 (1)</p> <p data-bbox="991 573 1501 636">the ionic charges must not be shown in the nucleus</p> <p data-bbox="991 672 1477 734">award 0 marks for structures with shared electrons</p> <p data-bbox="991 770 1493 869">One electronic structure must be labelled in some way to indicate which ion is which in order to score two marks.</p> <p data-bbox="991 904 1501 1003">allow answers showing the transfer of electrons providing the same electrons are not shown twice</p> <p data-bbox="991 1039 1414 1070">all electrons can be dots or crosses</p> <p data-bbox="991 1106 1278 1137">Examiner's Comments</p> <p data-bbox="991 1173 1509 1603">Most candidates attempted to draw an ionic rather than a covalent 'dot-and-cross' diagram however some neglected to include the charges on the ions. Other candidates did not show the full electronic structures which were required in this question. Candidates should be advised not to show the charge on the ions in the nucleus but should show the on the outside of the structure. Another misconception was to draw the electron transferred twice both in the shell of the sodium atom and in the outer shell of the fluoride ion.</p>
	Total	2	

Question	Answer/Indicative content	Marks	Guidance
14	<p>idea of an attraction or bond(ing) between positive ions and electrons (1)</p> <p>(closely packed) metal ions and delocalised electrons (1)</p>	2	<p>do not allow intermolecular forces / covalent bonding / ionic bonding / metal molecules = 0 for the question</p> <p>allow positive atoms, cations, positive ions instead of metal ions and free electrons instead of delocalised electrons.</p> <p>allow has electrons free to move instead of delocalised or free electrons / sea of electrons instead of delocalised electrons</p> <p>allow mark could be found on a labelled diagram (metal ion)</p>  <p>free electrons</p> <p>Examiner's Comments</p> <p>Most candidates could not describe metallic bonding and a significant proportion of candidates left this question blank. The best answers described the attraction between the delocalised electrons and positive ions however most candidates did not even appreciate that a metal has positive ions. Candidates often drew diagrams that were not labelled and did not show the positive ions in a closed packed arrangement. A small proportion of candidates tried to draw 'dot and cross' diagrams. Other candidates referred to ionic, covalent and intermolecular forces.</p>
	Total	2	

Question		Answer/Indicative content	Marks	Guidance
15	a	beryllium / calcium / strontium / barium / radium (1)	1	<p>allow Be / Ca / Sr / Ba / Ra (1)</p> <p>Examiner's Comments</p> <p>Most candidates correctly identified a group 2 element. Calcium was the commonest correct answer. Sodium was the most frequent incorrect answer.</p>
	b	sodium / aluminium / silicon / phosphorus / sulfur / chlorine / argon (1)	1	<p>allow Na / Al / Si / P / S / Cl / Ar (1)</p> <p>Examiner's Comments</p> <p>Again this question was well answered. Sodium was the commonest correct answer, although aluminium and chlorine also featured. Confusion between groups and periods was seen from a minority of candidates who offered calcium.</p>
	c	group 2 (1) 3 rd period (1)	2	<p>Examiner's Comments</p> <p>About half of candidates failed to score on this question. Many candidates scored 1 mark for correctly identifying group 2. Fewer also identified the 3rd period. A common misconception was period 2.</p>
		Total	4	

Question		Answer/Indicative content	Marks	Guidance
16	a	K (1)	1	<p>allow potassium</p> <p>Examiner's Comments</p> <p>Both data interpretation questions were well answered by the majority of candidates.</p>
	b	<p>any two from:</p> <p>high boiling point (1)</p> <p>(good) thermal conductor (1)</p> <p>(good) electrical conductor (1)</p> <p>high density (1)</p> <p>malleable / flexible (1)</p> <p>ductile (1)</p> <p>lustrous (1)</p> <p>hard (1)</p> <p>high tensile strength (1)</p> <p>sonorous (1)</p> <p>have basic oxides (1)</p> <p>form positive ions (1)</p> <p>form ionic compounds (1)</p>	2	<p>ignore just a good conductor</p> <p>ignore just dense</p> <p>allow shiny</p> <p>allow strong</p> <p>allow often react with acids to give hydrogen</p> <p>Examiner's Comments</p> <p>Not well answered. A lot of the candidates talked about metallic structure without mentioning any property, many others gave uses for metals.</p>
		Total	3	

Question		Answer/Indicative content	Marks	Guidance
17	a	Mg and Ca / He and Ne(1)	1	both needed allow MG and CA / HE and NE allow magnesium and calcium / helium and neon answer must be in table Examiner's Comments Many correct answers except for a few candidates who mixed up "group" and "period".
	b	O and Ne / Mg and Cl(1)	1	both needed allow NE / MG and CL / Cl ₂ allow oxygen / O ₂ and neon / magnesium and chlorine answer must be in table Examiner's Comments Many correct answers except for a few candidates who mixed up "group" and "period".
		Total	2	
18		any two from hard (1) high density (1) high tensile strength / strong (1) (good) conductors of electricity (1) (good) conductors of heat (1) malleable (1) ductile / can be made into wires (1) sonorous / when hit makes ringing sound (1)	2	allow good conductors (1) if no marks awarded for conductors of heat and electricity allow can be hammered into shape (1) ignore bendy / flexible ignore durable / tough / hardwearing / long lasting Examiner's Comments Most candidates could describe at least one correct property of metals with many giving two. 'Hard' was a common correct answer. Incorrect answers included 'lightweight' and 'a solid'.
		Total	2	