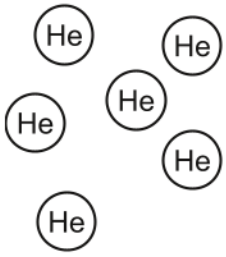
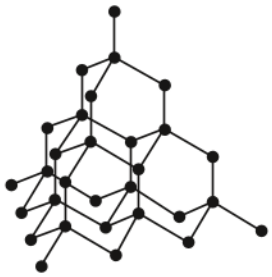
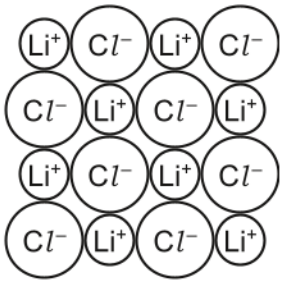
1 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



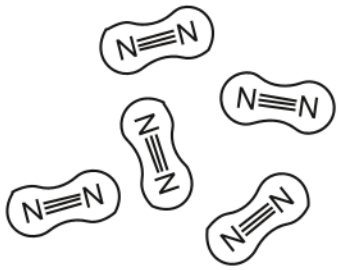
A



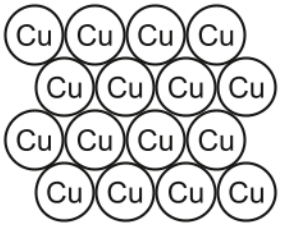
B



C



D



E

(a) Answer the following questions about these structures.
Each structure may be used once, more than once or not at all.

(i) Which **two** of these structures, **A**, **B**, **C**, **D** or **E**, are covalently bonded?

..... and ..... [2]

(ii) Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, is a diatomic molecule?

..... [1]

(iii) Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, is a compound?

..... [1]

(iv) Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, is very soluble in water?

..... [1]

(v) Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, is used in cutting tools?

..... [1]

(vi) Which **one** of these structures, **A**, **B**, **C**, **D** or **E**, is used in electrical wiring?

..... [1]

(b) Substance **B** is an element.

What is meant by the term *element* ?

.....

..... [1]

[Total: 8]

2 Magnesium is a metal.

Name and describe the bonding in magnesium.

name .....

description of bonding .....

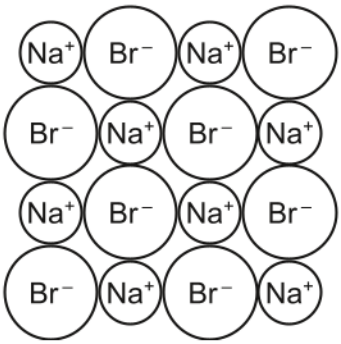
.....

..... [4]

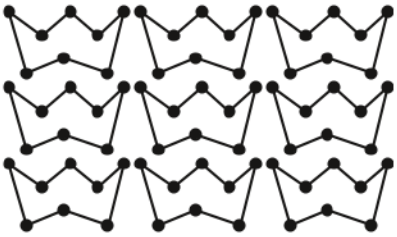
[Total: 4]

3 The diagram shows part of the structures of sodium bromide and sulfur.

sodium bromide



sulfur



Describe both sodium bromide and sulfur in terms of:

- bonding

.....

.....

.....

.....

- electrical conductivity

.....

.....

- solubility in water.

.....

..... [5]

[Total: 5]

4 The table shows the melting points, boiling points and electrical conductivities of six substances **D**, **E**, **F**, **G**, **H** and **I**.

substance	melting point / °C	boiling point / °C	electrical conductivity when solid	electrical conductivity when liquid
D	1610	2230	non-conductor	non-conductor
E	801	1413	non-conductor	good conductor
F	–119	43	non-conductor	non-conductor
G	1535	2750	good conductor	good conductor

H	114	184	non-conductor	non-conductor
I	–210	−196	non-conductor	non-conductor

Choose substances from the table which match the following descriptions. Each substance may be used once, more than once or not at all.

(a) Which substance is a liquid at 25 °C

..... [1]

(b) Which substance is a gas at 25 °C?

..... [1]

(c) Which **three** substances contain simple molecules?

..... [3]

(d) Which substance could be a metal? Give a reason for your answer.

substance .....

reason .....

..... [2]

(e) Which substance has a macromolecular structure? Give **two** reasons for your answer.

substance .....

reason 1 .....

reason 2 ..... [3]

(f) Which substance is an ionic solid? Give **one** reason for your answer.

substance .....

reason .....

..... [2]

[Total: 12]

5 Iodine reacts with chlorine to form iodine monochloride, ICl, as the only product.

Draw a dot-and-cross diagram to show the electron arrangement in a molecule of iodine monochloride. Show outer shell electrons only.

[2]

[Total: 2]

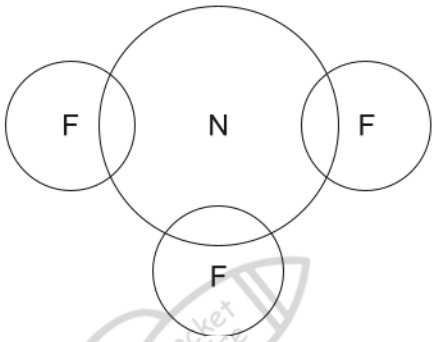
6 NF_3 has covalent bonds.

(a) What is a covalent bond?

.....

..... [2]

(b) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of NF_3. Show outer shell electrons only.



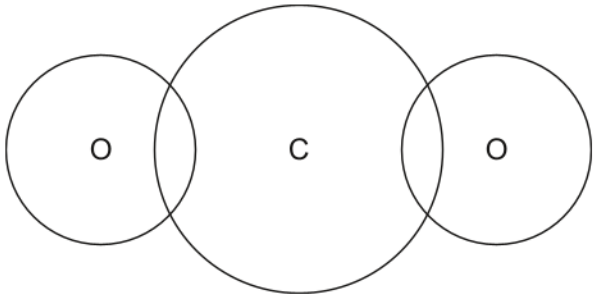
[3]

[Total: 5]

7 Carbon dioxide, CO_2, is a covalent molecule.

Complete the diagram to show the electron arrangement in one molecule of CO_2.

Show only the outer electrons.



[2]

[Total: 2]

8 The table shows the melting points of ethanol and sodium chloride.

substance	melting point / °C
ethanol	–114
sodium chloride	801

The difference in melting points is due to differences in attractive forces between particles in these substances.

Name the type of attractive force in each substance, which is responsible for the difference in melting points.

ethanol .....

sodium chloride ..... [2]

[Total: 2]

9 The names of eight substances are given.

aluminium oxide **calcium oxide** **ethanol** **nitrogen**

iron(III) oxide **methane** **oxygen** **silicon(IV) oxide**

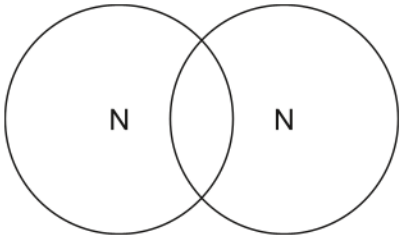
State which substance is a macromolecular solid.

..... [1]

[Total: 1]

10 This question is about nitrogen.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of nitrogen, N_2.
Show the outer shell electrons only.

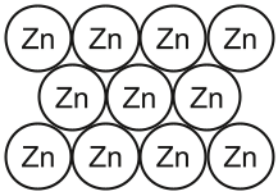


[2]

[Total: 2]

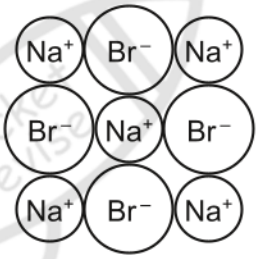
11 The diagrams show the structures of four substances, **R**, **S**, **T** and **U**.

R

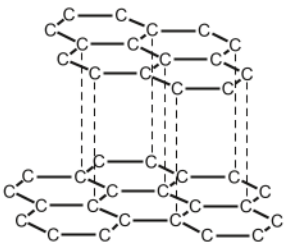


S

T



U



(a) Which **two** of these substances, **R**, **S**, **T** or **U**, are covalently bonded?

..... and ..... [2]

(b) Which **two** of these substances, **R**, **S**, **T** or **U**, conduct electricity when solid?

..... and ..... [2]

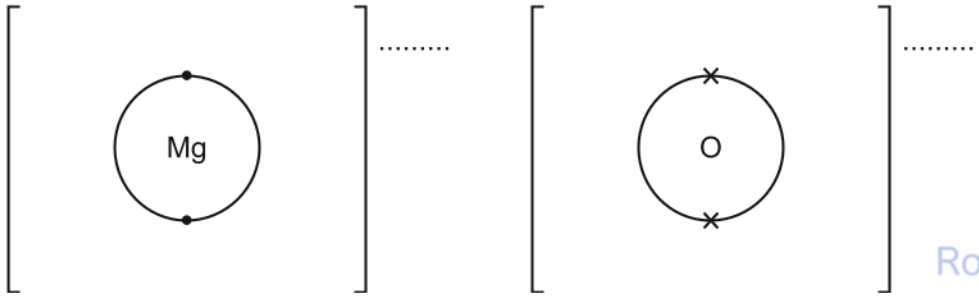
(c) Which substance, **R**, **S**, **T** or **U**, has the lowest melting point? ..... [1]

(d) Which **one** of these substances, **R**, **S**, **T** or **U**, is soluble in water? ..... [1]

[Total: 6]

12 Magnesium oxide, MgO, is formed when magnesium burns in oxygen.

Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium oxide.
The inner shells have been drawn.
Give the charges on the ions.



....

[3]

[Total: 3]

13 Give **three** physical properties that are typical of ionic compounds such as $MgCl_2$.

1 .....

2 .....

3 ..... [3]

[Total: 3]

14 Potassium bromide exists as an ionic lattice.

What is meant by the term *ionic lattice*?

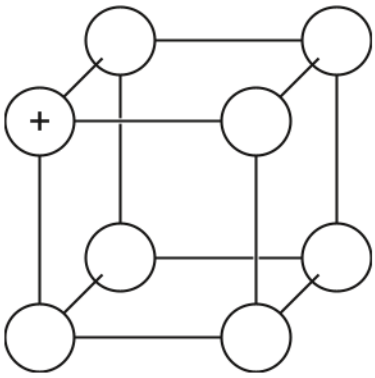
.....

..... [2]

[Total: 2]

15 Sodium chloride is a typical ionic compound.

(a) The diagram shows part of a lattice of sodium chloride.



Complete the diagram to show the ions present. Use '+' for Na+ ions and '–' for Cl^- ions.
One ion has been completed for you.

[2]

(b) How many electrons does a chloride ion have?

..... [1]

(c) Identify an element which has atoms with the same number of electrons as a sodium ion.

..... [1]

[Total: 4]

16 The table shows the properties of some alcohols.

alcohol	melting point /°C	boiling point /°C	volatility
methanol	–98	65	decreases ↓
ethanol	–114		
propanol	–126	98	
butanol	–89	117	

(a) What is the meaning of the term *volatility*?

..... [1]

(b) Which alcohol in the table has the highest melting point?

..... [1]

(c) Predict the boiling point of ethanol.

..... [1]

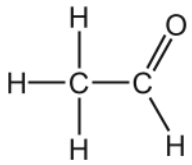
(d) What is the state of propanol at 120 °C? Explain your answer.

.....

..... [2]

[Total: 5]

17 The structural formula of ethanal is shown.

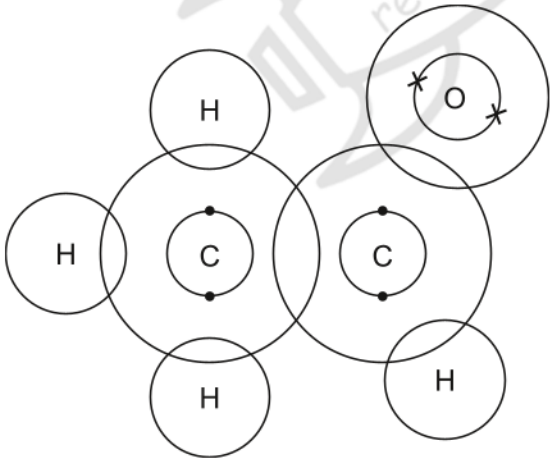


The C=O group in aldehydes is at the end of the carbon chain.
This is a reactive part of the molecule.

(a) What is the name given to the reactive part of any organic molecule?

..... [1]

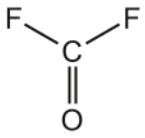
(b) Complete the dot-and-cross diagram to show the electron arrangement of a molecule of ethanal.
Inner shells have been drawn.



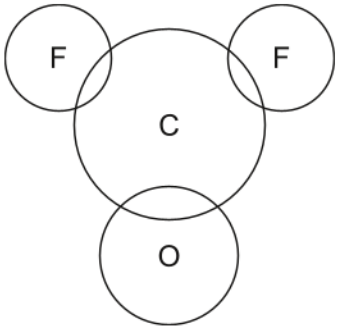
[3]

[Total: 4]

18 Carbonyl fluoride, COF_2, is a covalent compound. The structure of a molecule of COF_2 is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of carbonyl fluoride. Show outer shell electrons only.



[3]

[Total: 3]

19 Calcium is in Group II and chlorine is in Group VII of the Periodic Table.

Explain, in terms of number of outer shell electrons and electron transfer, how calcium atoms and chlorine atoms form ions. Give the formulae of the ions formed.

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 5]

20 Lithium fluoride has ionic bonding.

What is an ionic bond?

.....

..... [2]

[Total: 2]

21 Group V chlorides are covalent molecules. The boiling points of some Group V chlorides are shown.

chloride	boiling point / °C
NCl_3	71
PCl_3	
$AsCl_3$	130
$SbCl_3$	238

(a) Suggest the approximate boiling point of PCl_3.

..... [1]

(b) Explain the trend in boiling points in terms of attractive forces between particles.

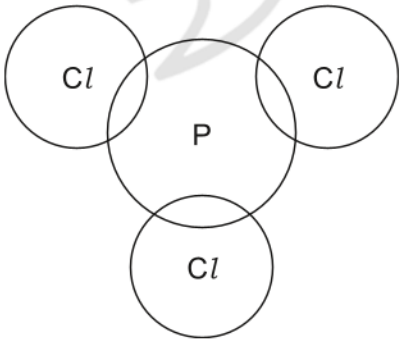
.....

..... [2]

[Total: 3]

22 Complete the dot-and-cross diagram to show the electron arrangement in a molecule of PCl_3.

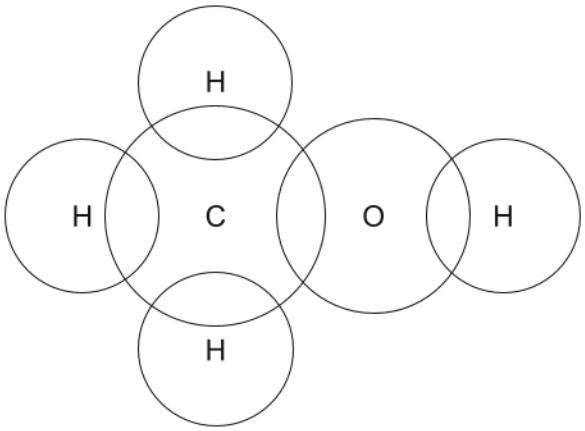
Show outer electrons only.



[3]

[Total: 3]

23 Draw a dot-and-cross diagram to show the electron arrangement in a molecule of methanol. Show outer shell electrons only.



[2]

[Total: 2]

24 The table gives the boiling points of ethanal and ethanol.

substance	boiling point / °C
ethanal	20
ethanol	78

In terms of attractive forces between particles, suggest why ethanal has a lower boiling point than ethanol.

.....

..... [1]

[Total: 1]

25 Many substances conduct electricity.

Identify all the particles responsible for the passage of electricity in:

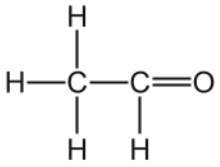
graphite .....

magnesium ribbon .....

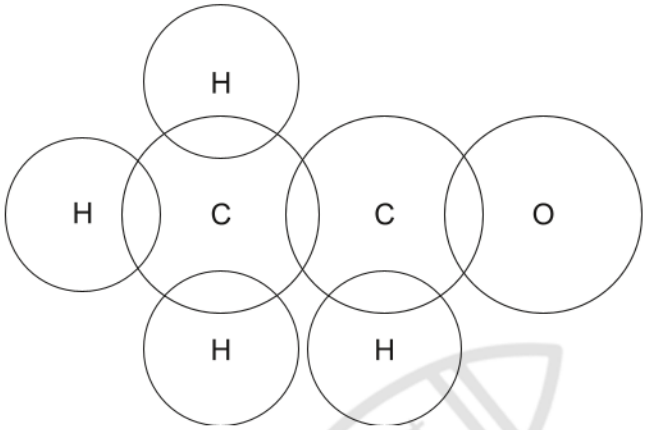
molten copper(II) bromide..... [4]

[Total: 4]

26 The structure of ethanal is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethanal. Show outer shell electrons only.



[3]

[Total: 3]

27 Magnesium is a metal.

Describe the structure and bonding of metals. Include a labelled diagram in your answer.

.....

.....

.....

..... [3]

[Total: 3]

28 This question is about phosphorus.

Phosphorus has the formula P_4. Some properties of P_4 are shown.

melting point / °C	45
boiling point / °C	280
electrical conductivity	non-conductor
solubility in water	insoluble

(a) Name the type of bonding that exists between the atoms in a P_4 molecule.

..... [1]

(b) Explain, in terms of attractive forces between particles, why P_4 has a low melting point.

.....

..... [1]

(c) Explain why phosphorus is a non-conductor of electricity.

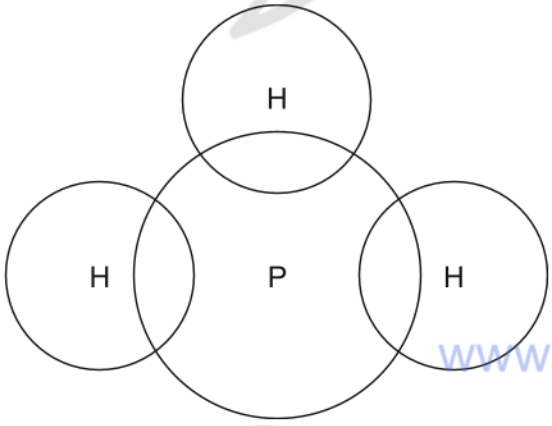
.....

..... [1]

[Total: 3]

29 Phosphine has the formula PH_3.

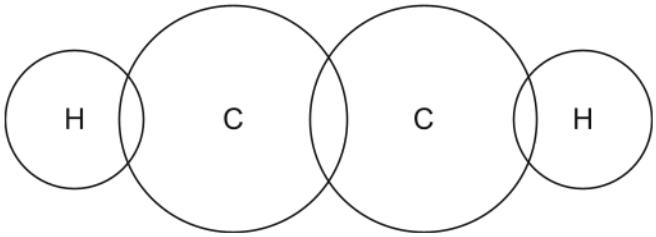
Complete the dot-and-cross diagram to show the electron arrangement in a molecule of phosphine. Show outer shell electrons only.



[2]

[Total: 2]

30 Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethyne, H–C≡C–H. Show outer shell electrons only.



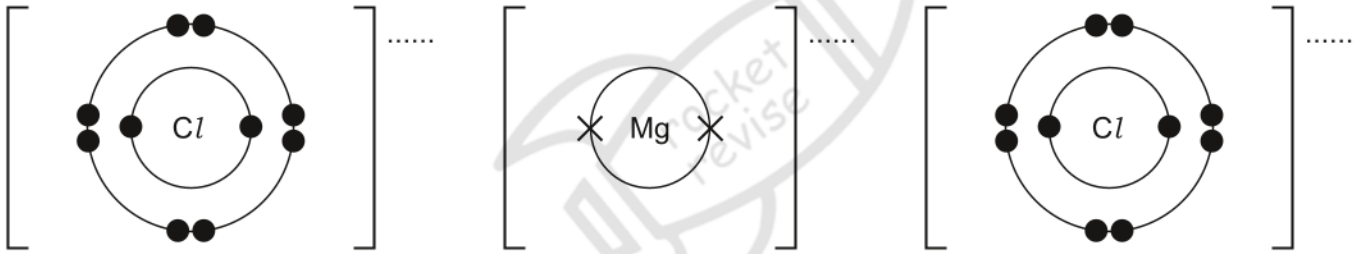
[2]

[Total: 2]

31 Magnesium is a Group II element.

Magnesium reacts with chlorine to form magnesium chloride, $MgCl_2$. Magnesium chloride is an ionic compound.

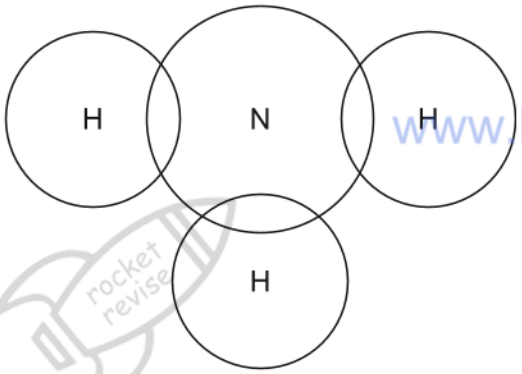
Complete the diagrams to show the electronic structures of the ions in magnesium chloride. Show the charges on the ions.



[3]

[Total: 3]

32 Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ammonia. Show outer shell electrons only.



[2]

[Total: 2]

33 Explain, in terms of structure and bonding, why potassium chloride has a much higher melting point than chlorine.

Your answer should refer to the:
- types of particle held together by the forces of attraction
- types of forces of attraction between particles
- relative strength of the forces of attraction.

.....

.....

.....

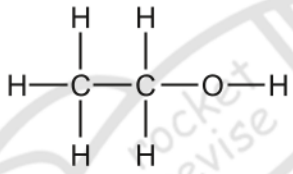
.....

.....

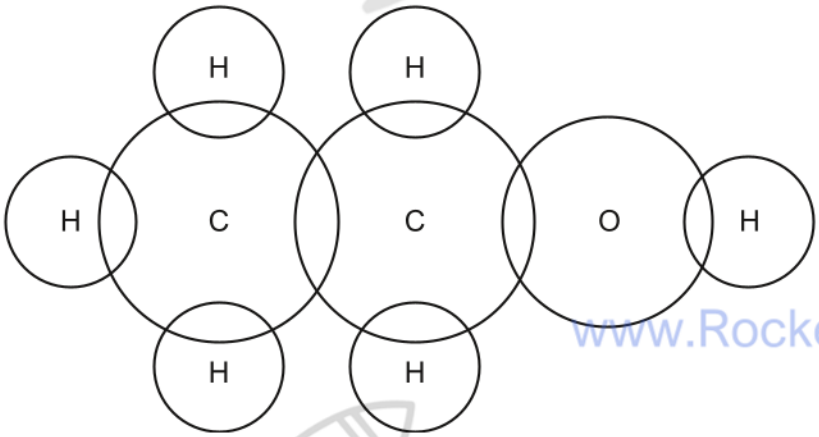
[3]

[Total: 3]

34 The structure of ethanol is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethanol. Show outer shell electrons only.



[2]

[Total: 2]

35 Potassium bromide has a melting point of 734 °C.
Iodine monochloride has a melting point of 27 °C.

In terms of attractive forces, explain why there is a large difference between these melting points.

.....

.....

.....

.....

..... [3]

[Total: 3]

36 Sulfur dichloride, SCl_2, is a covalent compound.

In terms of attractive forces, explain why $LiCl$ has a higher melting point than SCl_2.

.....

.....

.....

.....

..... [3]

[Total: 3]

37 Draw a dot-and-cross diagram to show the electron arrangements in the **two** ions present in lithium chloride, $LiCl$.

Show outer shell electrons only. Include the charges on the ions.

[3]

[Total: 3]

38 The melting points and boiling points of fluorine, F_2, and sodium fluoride, NaF, are shown.

	melting point / °C	boiling point / °C

fluorine	–220	–188
sodium fluoride	993	1695

(a) Deduce the physical state of fluorine at −195 °C. Use the data in the table to explain your answer.

physical state .....

explanation .....

..... [2]

(b) Explain, in terms of structure and bonding, why sodium fluoride has a much higher melting point than fluorine.

Your answer should refer to the:

- types of particle held together by the forces of attraction
- types of forces of attraction between particles
- relative strength of the forces of attraction.

.....

.....

.....

..... [3]

[Total: 5]

39 Sulfur dichloride, SCl_2, is a covalent compound. It has the structure Cl–S–Cl.

Draw a dot-and-cross diagram to show the electron arrangement in a molecule of sulfur dichloride.

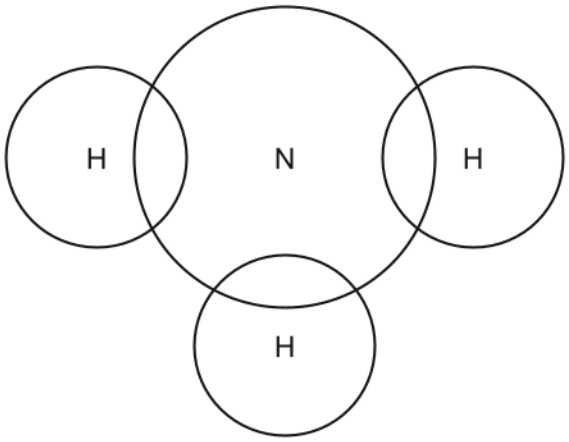
Show outer shell electrons only.

[3]

[Total: 3]

40 Aqueous ammonia is an alkali.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ammonia.



[2]

[Total: 2]