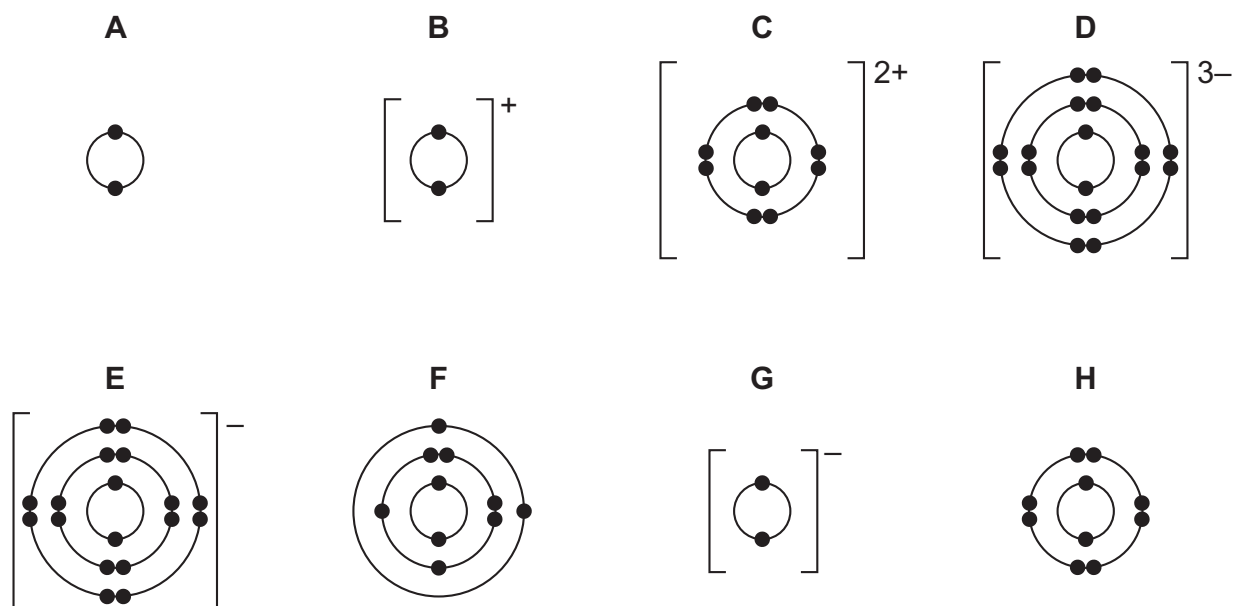


1 The electronic structures of some atoms and ions are shown.



(a) Write the letters, **A**, **B**, **C**, **D**, **E**, **F**, **G** or **H**, of the electronic structures which show:

(i) atoms of two different noble gases and

[2]

(ii) an ion of a Group I element

[1]

(iii) an ion of a Group V element

[1]

(iv) a pair of ions that could form a compound with the formula XY_2 and

[1]

(b) State which electronic structure, **A**, **B**, **C**, **D**, **E**, **F**, **G** or **H**, is incorrect.

Explain why.

incorrect electronic structure

explanation

..... [2]

(c) State how many protons are found in the nucleus of ion **C**.

[1]

(d) Use the Periodic Table to deduce:

(i) the chemical symbol for ion **G**

[1]

(ii) the element which forms an ion with a 3+ charge and the same electronic structure as **H**.

..... [1]

[Total: 10]

2 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]

3 Chlorine is in Group VII of the Periodic Table.

Two isotopes of chlorine are chlorine-35 and chlorine-37.

State why these two isotopes of chlorine have the same chemical properties.

.....

.....

..... [2]

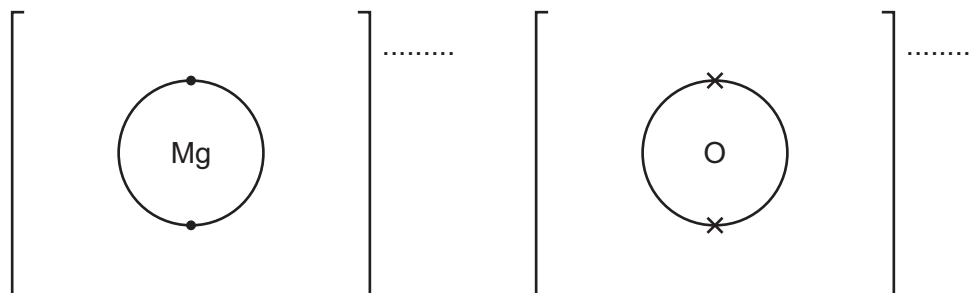
[Total: 2]

- 4 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.

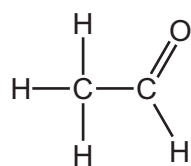
Give the charges on the ions.



[3]

[Total: 3]

- 5 The structural formula of ethanal is shown.

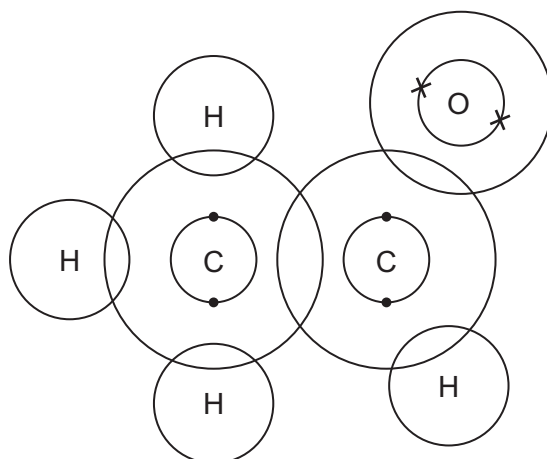


The C=O group in aldehydes is at the end of the carbon chain.
This is a reactive part of the molecule.

- (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.



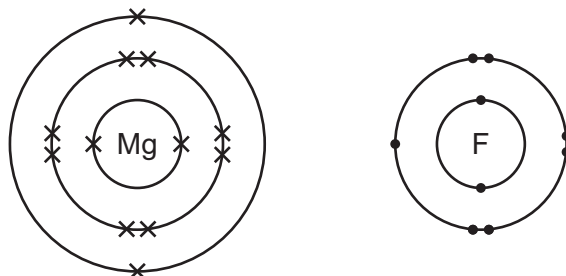
[3]

[Total: 4]

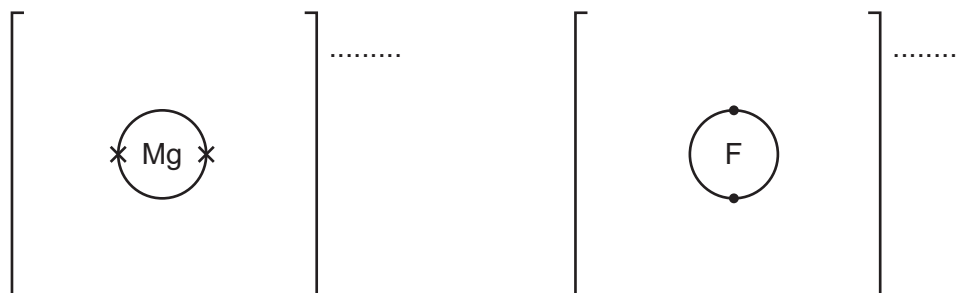
- 6 Fluorine forms both ionic and covalent compounds.

Magnesium reacts with fluorine to form the ionic compound magnesium fluoride.

The electronic structures of an atom of magnesium and an atom of fluorine are shown.



- (a) Complete the dot-and-cross diagrams to show the electronic structures of one magnesium ion and one fluoride ion. Show the charges on the ions.



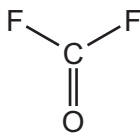
[3]

(b) What is the formula of magnesium fluoride?

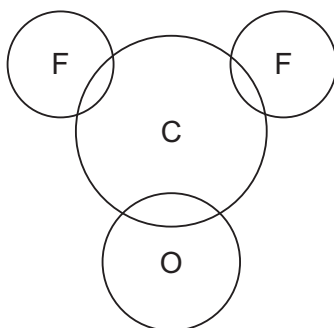
..... [1]

[Total: 4]

7 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]

8 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]

- 9 Lithium fluoride has ionic bonding.

What is an ionic bond?

.....

[2]

[Total: 2]

- 10 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]

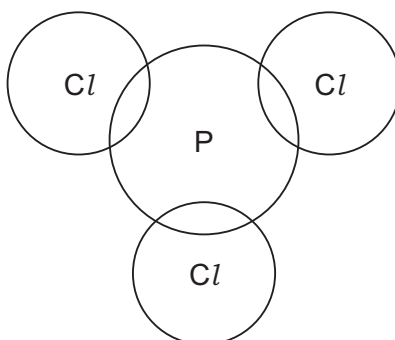
- (b) Explain the trend in boiling points in terms of attractive forces between particles.

..... [2]

[Total: 3]

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

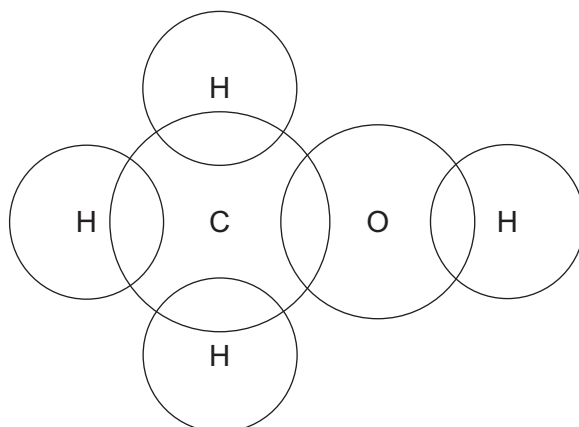
Show outer electrons only.



[3]

[Total: 3]

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



[2]

[Total: 2]

- 13 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]

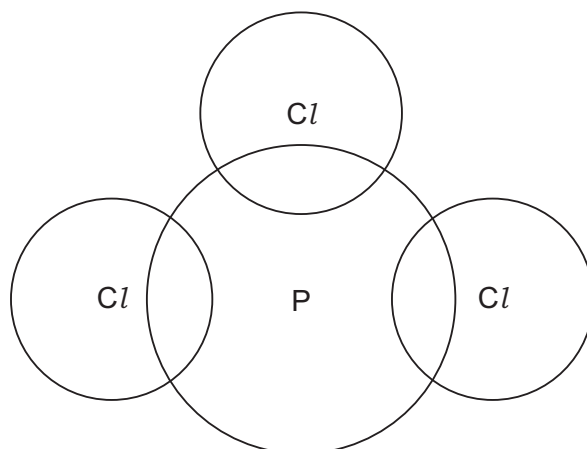
[Total: 12]

14 Phosphorus reacts with chlorine gas to produce phosphorus(III) chloride, PCl_3 .

(a) Write a chemical equation for the reaction between phosphorus and chlorine to produce phosphorus(III) chloride, PCl_3 .

..... [2]

- (b) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of phosphorus(III) chloride, PCl_3 . Show outer shell electrons only.



[2]

[Total: 4]

- 15 Many substances conduct electricity.

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

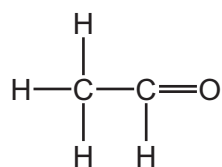
graphite

magnesium ribbon

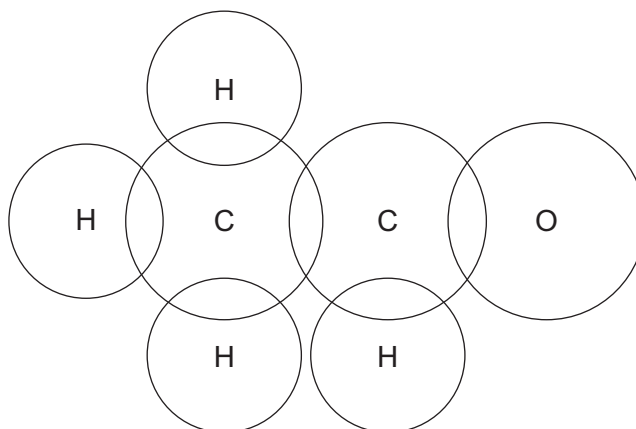
molten copper(II) bromide..... [4]

[Total: 4]

16 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]

17 The table gives information about atoms and ions **A**, **B** and **C**.

Complete the table.

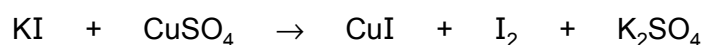
	number of electrons	number of neutrons	number of protons	symbol
A		14	13	${}_{13}^{27}\text{Al}$
B			12	${}_{12}^{25}\text{Mg}^{2+}$
C	10	10	9	

[6]

[Total: 6]

18 Aqueous potassium iodide reacts with aqueous copper(II) sulfate to produce iodine.

(a) Balance the chemical equation for this reaction.



[2]

(b) Deduce the charge on the copper ion in CuI.

..... [1]

(c) In terms of electron transfer, explain why copper is reduced in this reaction.

..... [1]

(d) Identify the reducing agent.

..... [1]

[Total: 5]

19 Complete the table to identify the atoms and ions which have the following numbers of protons, neutrons and electrons.

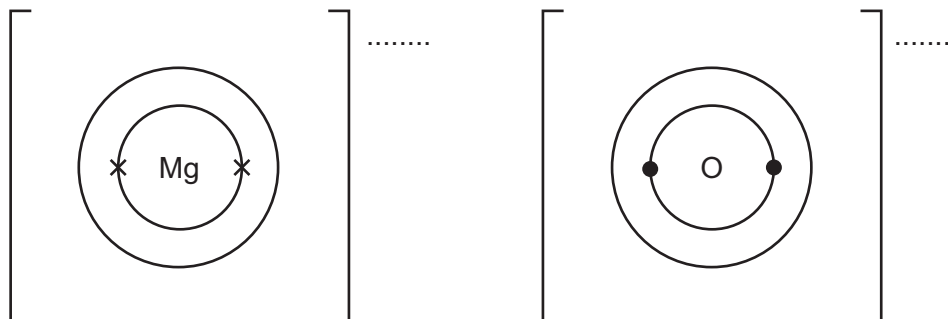
	number of protons	number of neutrons	number of electrons
${}_{11}^{23}\text{Na}^+$	11	12	10
	4	5	4
	17	20	18

[4]

[Total: 4]

20 Magnesium reacts with oxygen to form the ionic compound magnesium oxide.

(a) Complete the dot-and-cross diagrams to show the electronic structures of the ions in magnesium oxide. Show the charges on the ions.



[3]

(b) Magnesium oxide melts at 2853 °C.

Why does magnesium oxide have a high melting point?

.....
 [1]

(c) Explain why molten magnesium oxide can conduct electricity.

.....

 [1]

[Total: 5]

21

Magnesium exists as three isotopes, ${}_{12}^{24}\text{Mg}$, ${}_{12}^{25}\text{Mg}$ and ${}_{12}^{26}\text{Mg}$.

All isotopes of magnesium react with dilute hydrochloric acid to make hydrogen and a salt.

(a) Why do all isotopes of magnesium react in the same way?

.....

 [2]

(b) Write a chemical equation for the reaction between magnesium and dilute hydrochloric acid.

..... [2]

(c) Describe a test for hydrogen.

test

result [2]

[Total: 6]

22 Magnesium is a metal.

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

.....

.....

.....

..... [3]

[Total: 3]

23 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]

24 Tetrafluoromethane and lead(II) fluoride are fluorides of Group IV elements. Some properties of tetrafluoromethane and lead(II) fluoride are shown in the table.

property	tetrafluoromethane	lead(II) fluoride
formula	CF ₄	
melting point / °C	-184	855
boiling point / °C	-127	1290
conduction of electricity when solid	non-conductor	non-conductor
conduction of electricity when molten	non-conductor	good conductor

(a) What is the formula of lead(II) fluoride?

..... [1]

(b) What type of bonding is present between the atoms in tetrafluoromethane?

..... [1]

(c) What type of structure does solid lead(II) fluoride have?

..... [1]

(d) Explain, in terms of attractive forces between particles, why lead(II) fluoride has a much higher melting point than tetrafluoromethane.

In your answer refer to the types of attractive forces between particles and their relative strengths.

.....

 [3]

[Total: 6]

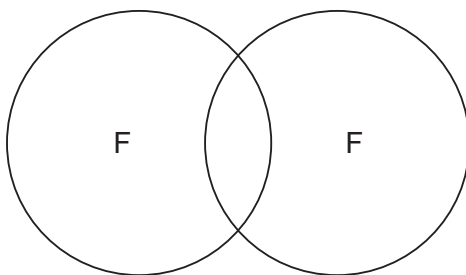
25 Fluorine is a Group VII element. Fluorine forms compounds with metals and non-metals.

(a) Predict the physical state of fluorine at room temperature and pressure.

..... [1]

- (b) Fluorine exists as diatomic molecules.

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



[2]

- (c) Write a chemical equation for the reaction between sodium and fluorine.

..... [2]

- (d) Explain why chlorine does **not** react with aqueous sodium fluoride.

..... [1]

[Total: 6]

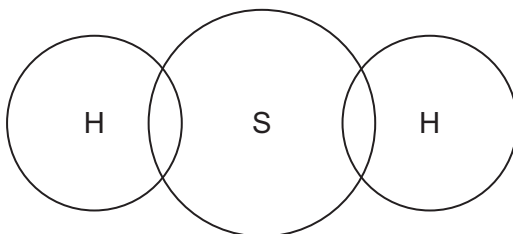
- 26 The gas hydrogen sulfide, H_2S , is produced when concentrated sulfuric acid is added to solid potassium iodide.

The reaction involves oxidation.

- (a) Define the term *oxidation* in terms of electron transfer.

..... [1]

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



[2]

(c) Hydrogen sulfide has a simple molecular structure.

Explain why hydrogen sulfide has a low boiling point.

.....

.....

.....

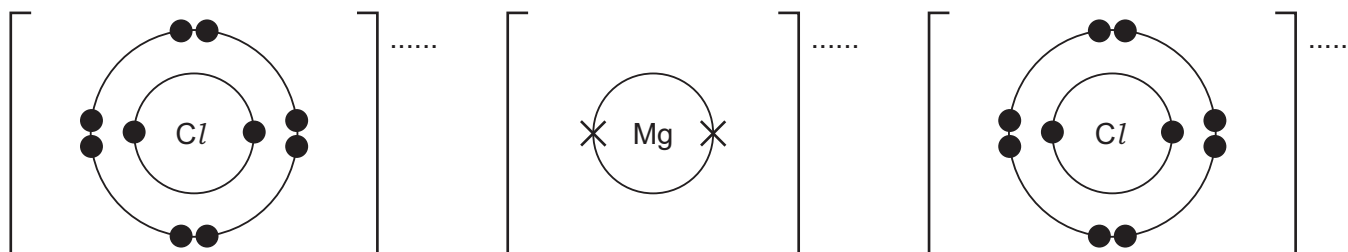
[2]

[Total: 5]

27 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]

28 Complete the table to show the number of nucleons, neutrons and electrons in an ${}_{13}^{27}Al^{3+}$ ion.

	number in ${}_{13}^{27}Al^{3+}$
nucleons	
neutrons	
electrons	

[3]

[Total: 3]

- 29 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]

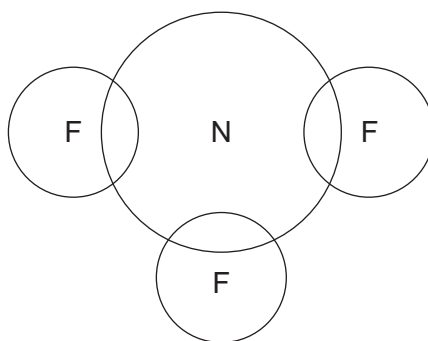
- 30 NF_3 has covalent bonds.

(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]

- 31 Air is a mixture. Nitrogen and oxygen are the two most common gases in air.

(a) What is meant by the term *mixture*?

.....

[1]

(b) State the percentage of oxygen, to the nearest whole number, in clean dry air.

.....

[1]

- (c) Describe the steps in the industrial process which enables nitrogen and oxygen to be separated from clean dry air.

Use scientific terms in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[3]

- (d) Which physical property of nitrogen and oxygen allows them to be separated?

.....

[1]

[Total: 6]

32 Carbon and silicon are elements in Group IV of the Periodic Table.
Carbon dioxide from the air moves into green plants and is converted into carbohydrates.

- (a) Name the process by which carbon dioxide molecules move through the air into green plants.

.....

[1]

- (b) Explain why silicon(IV) oxide **cannot** move through the air in the same way that carbon dioxide can.

.....

[1]

- (c) Name the process by which carbon dioxide is converted into glucose, $C_6H_{12}O_6$, in green plants.
Give **two** conditions required for this process to occur.
Write a chemical equation for the reaction which occurs.

name of process

condition 1

condition 2

chemical equation

[5]

[Total: 7]

33 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]

34 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]

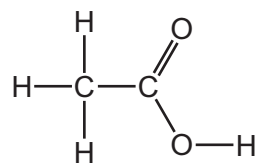
[Total: 3]

35 Ethanol can be oxidised to form ethanoic acid.

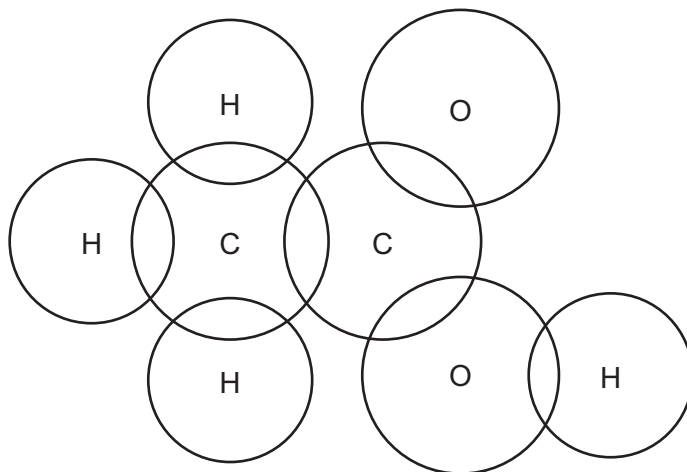
(a) Name a suitable oxidising agent for this reaction.

..... [1]

(b) A molecule of ethanoic acid has the structure shown.



Complete the dot-and-cross diagram to show the electron arrangement in ethanoic acid. Show outer shell electrons only.



[3]

[Total: 4]

36 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]

(a) Describe the bonding in iron. Include a diagram in your answer.

.....
 [3]

(b) Use your diagram in (a) to explain why iron is malleable.

.....
 [2]

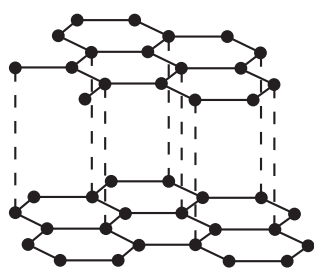
(c) Iron containing a small amount of carbon is known as steel.

Explain why steel is less malleable than iron.

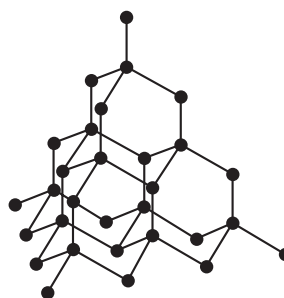
.....
 [2]

[Total: 7]

38 Two macromolecular forms of carbon are graphite and diamond. The structures of graphite and diamond are given below.



graphite



diamond

- (a) Explain in terms of its structure why graphite is soft and is a good conductor of electricity.

.....

.....

.....

.....

.....

[3]

- (b) State **two** uses of graphite which depend on the above properties.

It is soft

.....

It is a good conductor of electricity

.....

[2]

[Total: 5]

- 39** Nitrogen can form ionic compounds with reactive metals and covalent compounds with non-metals.

Nitrogen reacts with lithium to form the ionic compound lithium nitride, Li_3N .

- (a) Write the equation for the reaction between lithium and nitrogen.

.....

[2]

- (b) Lithium nitride is an ionic compound. Draw a diagram which shows its formula, the charges on the ions and the arrangement of the valency electrons around the negative ion.

Use x for an electron from a lithium atom.

Use o for an electron from a nitrogen atom.

[2]

[Total: 4]

- 40 In the Periodic Table, the elements are arranged in columns called Groups and in rows called Periods.

(a) Complete the table for some of the elements in Period 3.

group number	I	II	III	IV	V	VI	VII
symbol	Na	Mg	Al	Si	P	S	Cl
number of valency electrons							
valency							

[2]

(b) What is the relationship between the group number and the number of valency electrons?

.....

.....

[1]

(c) Explain the relationship between the number of valency electrons and the valency for the elements Na to Al,

.....

.....

.....

for the elements P to Cl.

.....

.....

.....

[4]

[Total: 7]