

2 Ionic compounds contain ions.

(a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 5.

particle	electrons	neutrons	protons
W	9	10	9
X	10	14	12
Y	16	16	16
Z	18	18	16

Figure 5

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

.....

.....

.....

.....

(b) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate, $\text{Ca}(\text{NO}_3)_2$.
(relative atomic masses: Ca = 40, N = 14, O = 16)

(2)

relative formula mass =

(c) Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 6.

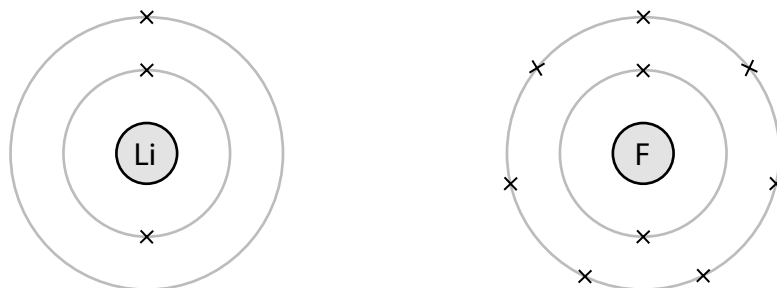


Figure 6

Complete Figure 7 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)

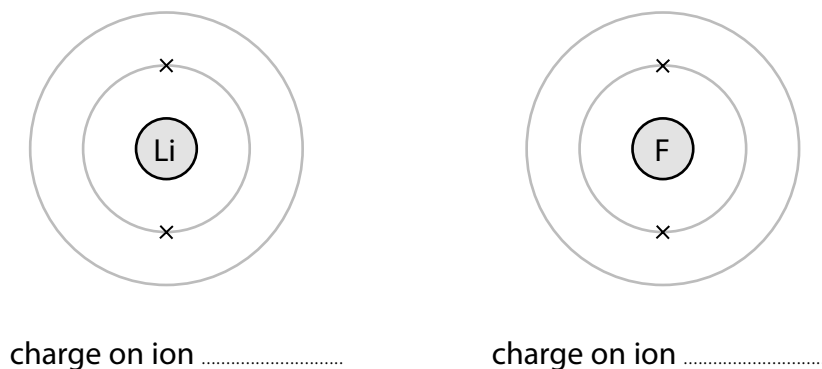


Figure 7

(Total for Question 2 = 8 marks)

Structures

2 The table shows some properties of diamond and graphite.

diamond	graphite
colourless crystals	black, shiny solid
very hard	flakes easily
does not conduct electricity	conducts electricity

(a) (i) Suggest why diamond and graphite might be expected to have similar properties.

(1)

(ii) By referring to its structure, explain why diamond is very hard.

(3)

(iii) By referring to its structure, explain why graphite flakes easily.

(2)



(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Carbon dioxide is a gas at room temperature.

A carbon dioxide molecule is a

(1)

- A giant molecule that has covalent bonds
- B giant molecule that has ionic bonds
- C simple molecule that has covalent bonds
- D simple molecule that has ionic bonds

(c) The atomic number of carbon is 6 and of fluorine is 9.

Carbon and fluorine atoms are combined in a tetrafluoromethane molecule, CF_4 .

Draw a dot and cross diagram of a tetrafluoromethane molecule.

Show outer electrons only.

(2)

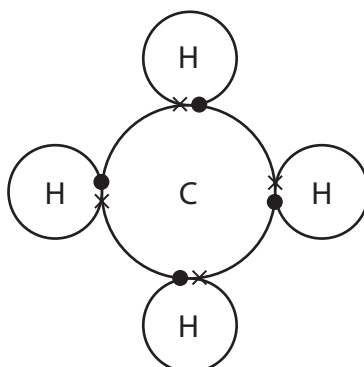
(Total for Question 2 = 9 marks)



Covalent substances

5 Many substances exist as molecules.

(a) The diagram shows the outer shell electrons in a molecule of methane, CH_4 .



(i) Each hydrogen atom is bonded to the carbon atom by a covalent bond.

Give the meaning of the term **covalent bond**.

(1)

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Methane is a typical simple molecular, covalent compound.

A property of methane is that

(1)

- A it has a high melting point
- B it is a good conductor of electricity
- C there are weak bonds in its molecule
- D it has a low boiling point



(b) Nitrogen and oxygen are gases in air.

Describe how samples of nitrogen and oxygen can be obtained from air.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(c) Graphite is a form of the element carbon.
Graphite is a giant molecular, covalent substance.

Use the structure and bonding in graphite to explain why it is able to be used as a lubricant and as a conductor of electricity.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Give a use of graphite that depends on its ability to conduct electricity.

(1)

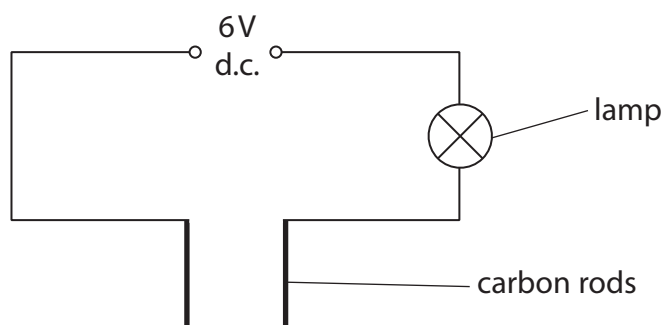
.....

.....

(Total for Question 5 = 12 marks)



*(c) This circuit was used to test the ability of water, solid sodium chloride and sodium chloride solution to conduct electricity.



The results were

substance	conducts electricity
water	no
solid sodium chloride	no
sodium chloride solution	yes

Explain these results by referring to the structures of the substances.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Answer ALL questions

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

Compounds

1 The table shows some properties of six compounds.

compound	melting point / °C	boiling point / °C	solubility in water	electrical conductivity of solution
copper sulfate	200	decomposes	soluble	high
hexane	-95	69	insoluble	does not dissolve
hydrogen chloride	-112	-85	soluble	high
octane	-57	126	insoluble	does not dissolve
silicon(IV) oxide	1610	2230	insoluble	does not dissolve
sodium chloride	801	1413	soluble	high

(a) Which of the following lists of compounds from the table contains only ionic compounds?

Put a cross (☒) in the box next to your answer.

(1)

- A copper sulfate, octane and sodium chloride
- B silicon(IV) oxide and sodium chloride
- C copper sulfate and sodium chloride
- D copper sulfate and silicon(IV) oxide

(b) Two of the compounds in the table produce a colour in a flame test.

Give the name of **one** of these compounds and the colour it produces in the flame test.

(2)

compound

colour



(c) Hexane is a covalent compound containing simple molecules.
It has a low boiling point.

(i) Explain why it has a low boiling point.

(2)

.....

.....

.....

.....

(ii) Hexane and water are immiscible.

Describe how separate samples of hexane and water can be obtained from a mixture of hexane and water.

(2)

.....

.....

.....

.....

(d) Draw a dot and cross diagram of a molecule of hydrogen chloride.

Show outer electrons only.

(2)

(Total for Question 1 = 9 marks)



Ionic substances

6 (a) The table shows the names and formulae of three ions.

name of ion	formula of ion
calcium	Ca^{2+}
nitrate	NO_3^-
phosphate	PO_4^{3-}

What is the formula of calcium nitrate?

Put a cross (☒) in the box next to your answer.

(1)

- A Ca_2NO_3
- B CaNO_3
- C Ca_3NO_2
- D $\text{Ca}(\text{NO}_3)_2$

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of oxygen atoms in the formula $\text{Ca}_3(\text{PO}_4)_2$ is

(1)

- A 2
- B 4
- C 8
- D 12



(c) The table gives some information about the elements sodium and sulfur.

	sodium	sulfur
metal or non-metal	metal	non-metal
atomic symbol	Na	S
number of electrons in one atom	11	16

Sodium sulfide is an ionic compound.

Describe, in terms of electron transfer, how sodium atoms react with sulfur atoms to form sodium sulfide.

Your description should include the charges on the ions formed.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

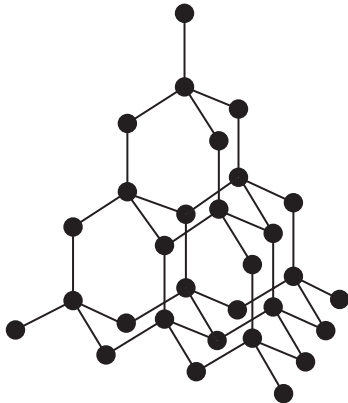
.....

.....

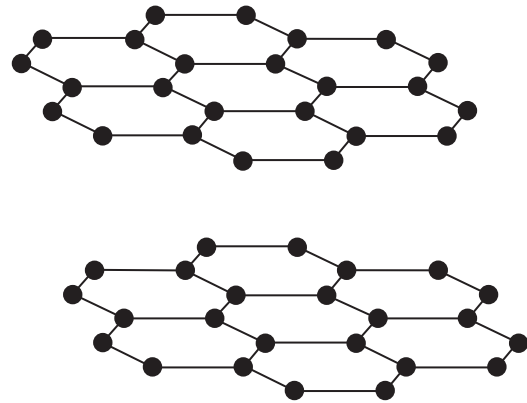


Bonding and properties

6 (a) The structures of diamond and graphite are shown.



diamond



graphite

(i) State the maximum number of covalent bonds formed by a carbon atom in a diamond crystal.

(1)

(ii) Which of the following statements about diamond and graphite is true?

Put a cross (☒) in the box next to your answer.

(1)

- A they are both good conductors of electricity
- B they are both soluble in water
- C they both cut glass
- D they both have high melting points

(iii) Explain, in terms of its structure, why graphite is able to be used as a lubricant.

(2)

.....

.....

.....

.....



(b) The atomic number of carbon is 6.

The atomic number of hydrogen is 1.

Draw a dot and cross diagram of a molecule of methane, CH_4 .

Show the outer shell electrons only.

(2)



*(d) Explain the difference in the ability of solid sodium chloride and molten sodium chloride to conduct electricity in terms of their structures.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS



Chlorine and carbon

- 5 (a) Chlorine has an atomic number of 17.
Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons		
number of neutrons		
number of electrons		

(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

.....

.....

.....

.....

- (b) Tetrachloromethane is a simple molecular, covalent compound.
The formula of its molecule is CCl_4 .

There are four electrons in the outer shell of a carbon atom.
There are seven electrons in the outer shell of a chlorine atom.

Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4 .

Show outer shell electrons only.

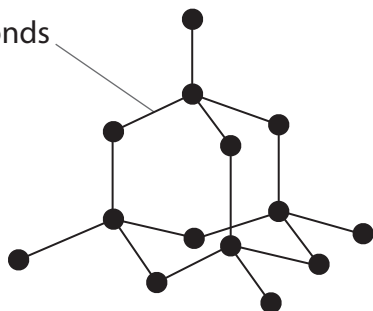
(2)



*(c) The diagrams show the arrangements of carbon atoms in diamond and in graphite.

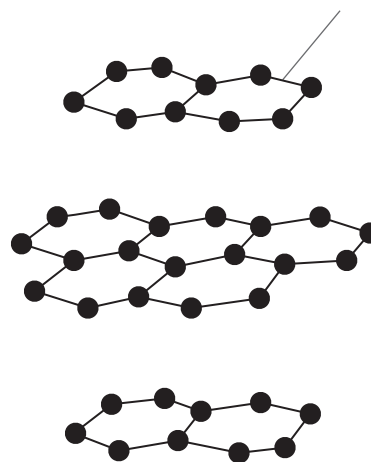
● = carbon atom

strong bonds



diamond

strong bonds



graphite

Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding and structure. In your answer you should use information from the diagrams.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 12 marks)

