

1 Carbon and silicon are elements in Group IV. Both elements have macromolecular structures.

(a) Diamond and graphite are two forms of the element carbon.

(i) Explain why diamond is a very hard substance.

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

(ii) Give **one** use of diamond.

..... [1]

(iii) Explain why graphite is a soft material.

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

(iv) Give **one** use of graphite.

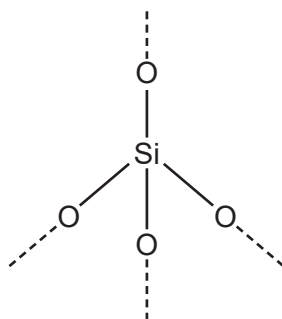
..... [1]

(b) Two of the oxides of these elements are carbon dioxide,  $\text{CO}_2$ , and silicon(IV) oxide,  $\text{SiO}_2$ .

(i) Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound carbon dioxide.  
Use x to represent an electron from a carbon atom.  
Use o to represent an electron from an oxygen atom.

[3]

(ii) A section of the macromolecular structure of silicon(IV) oxide is given below.



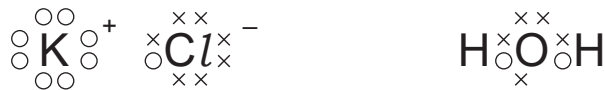
Use this diagram to explain why the formula is  $\text{SiO}_2$  not  $\text{SiO}_4$ .

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

(iii) Predict **two** differences in the physical properties of these two oxides.

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

2 The diagrams below show the electron arrangement in two compounds.



(a) In a water molecule, each hydrogen atom is bonded to the oxygen atom by sharing a pair of electrons.

Why does an oxygen atom share two pairs of electrons rather than just one pair?

.....  
..... [1]

(b) Describe how a potassium atom becomes a potassium ion.

..... [1]

(c) Why is there a bond between the ions in potassium chloride?

.....  
..... [1]

(d) Solid potassium chloride is a poor conductor of electricity. When dissolved in water it is a good conductor. Explain.

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

[Total: 5]

3 The following is a list of the electron distributions of atoms of unknown elements.

element	el distribution
<b>A</b>	2,5
<b>B</b>	2,8,4
<b>C</b>	2,8,8,2
<b>D</b>	2,8,18,8
<b>E</b>	2,8,18,8,1
<b>F</b>	2,8,18,18,7

(a) Choose an element from the list for each of the following descriptions.

- (i) It is a noble gas. .... [5]
- (ii) It is a soft metal with a low density. ....
- (iii) It can form a covalent compound with element **A**. ....
- (iv) It has a giant covalent structure similar to diamond. ....
- (v) It can form a negative ion of the type  $X^3$ . .... [5]

(b) Elements **C** and **F** can form an ionic compound.

- (i) Draw a diagram that shows the formula of this compound, the charges on the ions and the arrangement of the valency electrons around the negative ion.  
Use **o** to represent an electron from an atom of **C**.  
Use **x** to represent an electron from an atom of **F**.

[3]

- (ii) Predict **two** properties of this compound.

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

4 There are three types of giant structure – ionic, metallic and macromolecular.

(a) Sodium nitride is an ionic compound. Draw a diagram that shows the formula of the compound, the charges on the ions and the arrangement of the valency electrons around the negative ion.

Use x to represent an electron from a sodium atom.  
Use o to represent an electron from a nitrogen atom.

[3]

(b) Describe metallic bonding.

.....  
..... [3]

(ii) Use the above ideas to explain why  
metals are good conductors of electricity,

..... [1]  
metals are malleable.

..... [2]

(c) Silicon(IV) oxide has a macromolecular structure.

(i) **Describe** the structure of silicon(IV) oxide (a diagram is not acceptable).

.....  
.....  
..... [3]

(ii) Diamond has a similar structure and consequently similar properties.  
Give **two** physical properties common to both diamond and silicon(IV) oxide.

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

5 Complete the following table.

type of structure	particles present	electrical conductivity of solid	electrical conductivity of liquid	example
ionic	positive and negative ions	poor	.....	.....
macro molecular	atoms of two different elements in a giant covalent structure	poor		.....
metallic	..... and ..... .....	good	.....	copper

[Total: 6]

6 Magnesium reacts with bromine to form magnesium bromide.

(a) Magnesium bromide is an ionic compound. Draw a diagram that shows the formula of the compound, the charges on the ions and the arrangement of outer electrons around the negative ion.

The electron distribution of a bromine atom is 2, 8, 18, 7.

Use x to represent an electron from a magnesium atom.

Use o to represent an electron from a bromine atom.

[3]

(b) In the lattice of magnesium bromide, the ratio of magnesium ions to bromide ions is 1:2.

(i) Explain the term *lattice*.

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

(ii) Explain why the ratio of ions is 1:2.

..... [1]

(iii) The reaction between magnesium and bromine is redox. Complete the sentences.

Magnesium is the ..... agent because it has  
..... electrons.

Bromine has been ..... because it has .....  
electrons.

[Total: 10]

7 The table shows the melting points, boiling points and electrical properties of the six substances **A** to **F**.

substance	melting point / °C	boiling point / °C	electrical conductor at room temperature	electrical conductor of substance dissolved in water
<b>A</b>	961	2193	good	does not dissolve
<b>B</b>	113	444	does not conduct	does not dissolve
<b>C</b>	0	100	very poor	very poor
<b>D</b>	803	1465	does not conduct	good
<b>E</b>	-5 to -1	102 to 105	good	good
<b>F</b>	-8	-6	does not conduct	does not dissolve

(i) Which **three** substances are solids at room temperature?

..... [1]

(ii) Which **one** is an ionic compound?

..... [1]

(iii) Which **one** is a gas at room temperature?

..... [1]

(iv) Which **two** substances are liquids at room temperature?

..... [1]

(v) Which substance is a metal?

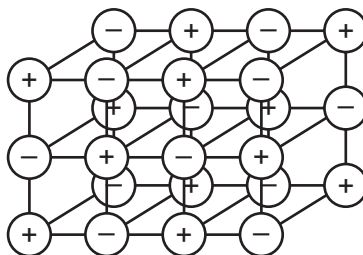
..... [1]

(vi) Which **one** is an impure substance?

..... [1]



- 8 (a) The structure of a typical ionic compound is a regular arrangement of positive and negative ions.



- (i) What is the name of this regular arrangement of particles?

..... [1]

- (ii) Give **two** physical properties of ionic compounds.

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

- (b) Ions are formed by electron loss or gain. The electron distribution of a magnesium atom is  $2 + 8 + 2$  and of a nitrogen atom is  $2 + 5$ .

- (i) Give the formula of the magnesium ion.

..... [1]

- (ii) Give the formula of the nitride ion.

..... [1]

- (iii) What is the formula of the ionic compound, magnesium nitride?

..... [1]

- (iv) In this compound there is an ionic bond. Why are the two ions attracted to each other?

..... [1]