Bonding part 5

Q1.

The drawing shows a container of a compound called magnesium chloride.

(i) How many elements are joined together to form magnesium chloride?

_____

(1)

(ii) Magnesium chloride is an ionic compound. What are the names of its ions?

_____ ions and _____ ions

(1)

(iii) How many **negative** ions are there in the formula for magnesium chloride?

_____

(1)

(iv) Complete the sentence.

Ions are atoms, or groups of atoms, which have lost or gained

_____ .

(1)

(v) Suggest **three** properties which magnesium chloride has because it is an ionic compound.

Property 1 _____

_____

Property 2 _____

_____

Property 3 _____

_____

(3)

(Total 7 marks)

Q2.

Part of the Periodic Table showing the symbols for the first twenty elements is given below.

		H							He
Li	Be		B	C	N	O	F	Ne	
Na	Mg		Al	Si	P	S	Cl	Ar	
K	Ca	Transition metals							

(a) Draw diagrams showing the arrangement of electrons (electronic structures) in:

(i) an aluminium atom;

(ii) a chlorine atom.

(2)

(b) (i) Use electronic structures to help you show why the formula of sodium oxide is Na_2O.

(3)

(ii) State why the formation of sodium ions is classified as an oxidation.

_____

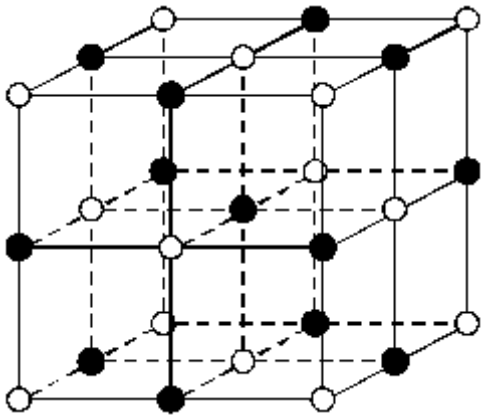
_____

(1)

(Total 6 marks)

Q3.

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



(i) Complete the spaces in the table to give information about **both** of the ions in this lattice.

Name of ion	Charge
_____	_____
_____	_____

(2)

(ii) When it is solid, sodium chloride will not conduct electricity. However, molten sodium chloride will conduct electricity. Explain this difference.

_____

_____

_____

_____

(2)

(iii) Complete the sentence.

Sodium chloride conducts electricity when it is molten and when it is

_____

(1)

(b) The symbol for a calcium atom can be shown like this:

$^{40}_{20}Ca$

(i) What is the mass number of this atom?

_____

(1)

(ii) What information is given by the mass number?

_____

_____

(1)

(c) Calcium burns in oxygen with a brick-red flame. The product is a white solid. It is calcium oxide and its formula is CaO.

(i) Balance the chemical equation for the reaction.

$$Ca(s) + O_2(g) \rightarrow CaO(s)$$

(1)

(ii) Describe, in terms of electrons, what happens to a calcium atom when it becomes a calcium ion.

_____

_____

_____

_____

(2)

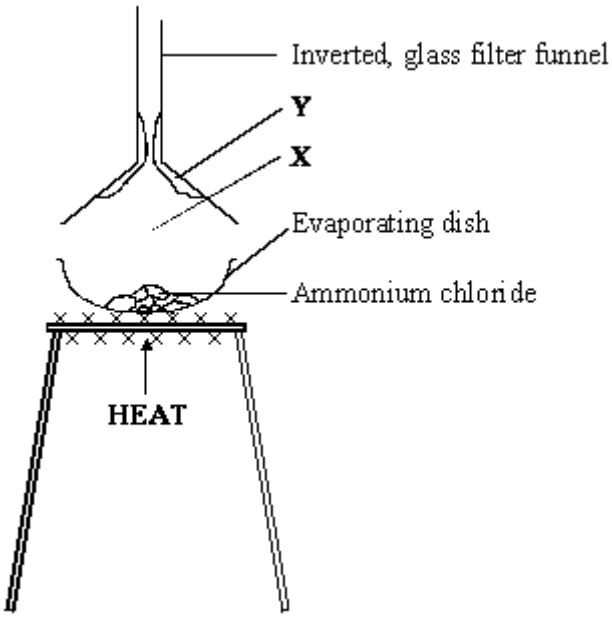
(Total 10 marks)

Q4.

(a) The equation for the reaction that takes place when ammonium chloride is heated is:

$$\underset{\text{ammonium chloride}}{NH_4Cl(s)} \rightleftharpoons \underset{\text{ammonia}}{NH_3(g)} + \underset{\text{hydrogen chloride}}{HCl\ (g)}$$

The diagram shows how a teacher demonstrated this reaction. The demonstration was carried out in a fume cupboard.



(i) Apart from the gases normally in the atmosphere, which two gases would be at **X**?

_____ and _____

(1)

(ii) Name the white solid that has formed at **Y**.

_____

(1)

(iii) Why was the demonstration carried out in a fume cupboard?

_____

_____

(1)

(iv) Complete the **four** spaces in the passage.

The chemical formula of ammonia is NH_3. This shows that there is one atom of _____ and three atoms of _____ in each _____ of ammonia. These atoms are joined by bonds that are formed by sharing pairs of electrons. This type of bond is called a _____ bond.

(4)

(b) Electrons, neutrons and protons are sub-atomic particles.

(i) Complete the **three** spaces in the table.

Name of sub-atomic particle	**Relative mass**	**Relative charge**
_____	1	+1
_____	1	0
_____	$\frac{1}{1840}$	–1

(2)

(ii) Which **two** sub-atomic particles are in the nucleus of an atom?

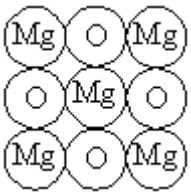
_____ and _____

(1)

(Total 10 marks)

Q5.

Magnesium oxide is a compound, made up of magnesium ions and oxide ions.



(a) What is the charge on each magnesium ion? _____

(1)

(b) Explain how the magnesium ions get this charge.

_____

_____

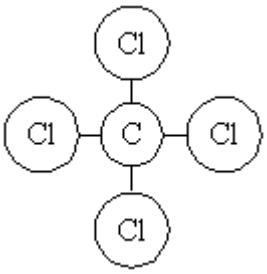
_____

(2)

(Total 3 marks)

Q6.

Chlorine will combine with the non-metal element, carbon, to form this molecular compound.



(a) What is the type of bond in this molecule?

_____

(1)

(b) Explain how these bonds are formed. (You may use a diagram).

_____

_____

_____

_____

(2)

(Total 3 marks)

Q7.

(a) By reference to their structure, explain how the particles in a piece of metal are held together and how the shape of the metal can be changed without it breaking.

(You may use a diagram in your answer.)

_____

_____

_____

_____

_____

_____

_____

(5)

(b) Explain why metals are good conductors of electricity and suggest why this conductivity increases across the periodic table from sodium to magnesium to aluminium.

_____

_____

_____

_____

_____

_____

_____

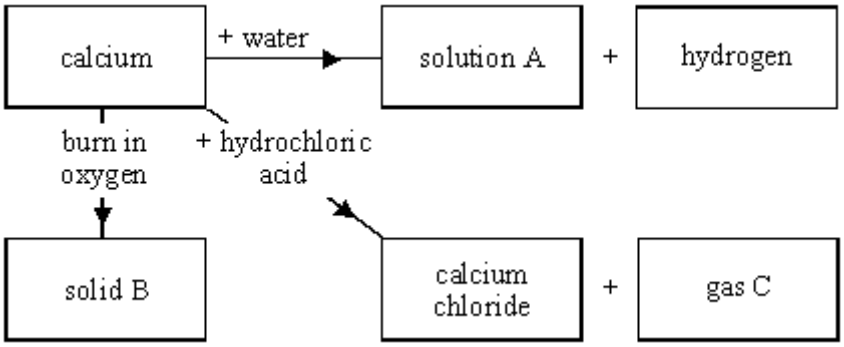
(4)

(Total 9 marks)

Q8.

(a) The chart shows the reactions of the metal calcium with water, oxygen and dilute

hydrochloric acid.



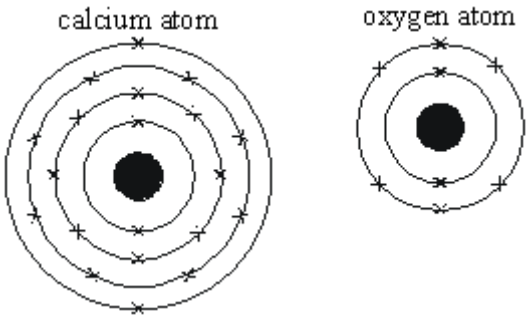
Name (i) solution A _____

(ii) solid B _____

(iii) gas C _____

(3)

(b) The diagrams below show the electronic structure of an atom of calcium and an atom of oxygen.



Describe fully what happens to its electrons when:

(i) a calcium atom forms a calcium ion. State the charge on the calcium ion formed.

_____

_____

_____

(3)

(ii) an oxygen atom forms an oxygen ion. State the charge on the oxygen ion formed.

_____

_____

_____

(3)

(c) Calcium oxide is an ionic compound. Why do ionic compounds have high melting points?

_____

(2)
(Total 11 marks)

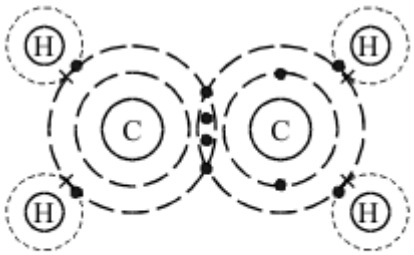
Q9.

The questions which follow refer to the element hydrogen.

(a) Draw a diagram to show the bonding in one molecule of hydrogen.

(2)

(b) The table gives information about two compounds which contain hydrogen.

NAME	FORMULA	STRUCTURE
dilute sulphuric acid	H_2SO_4	$[H]^+[SO_4]^{2-}[H]^+$
ethene	C_2H_4	

Use the information in the table to explain why it is difficult to classify hydrogen as a metal or a non metal.

(4)
(Total 6 marks)

Q10.

(a) Balance these chemical equations.

(i) H_2 + O_2 → H_2O

(1)

(ii) Al + O_2 → Al_2O_3

(1)

(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

_____

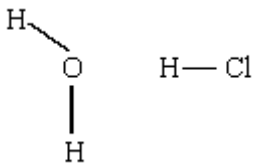
_____

_____

_____

(2)

(c) Explain, as fully as you can, why a water molecule contains two hydrogen atoms but a hydrogen chloride molecule contains only one.



(You may use a diagram in your answer if you wish).

_____

_____

_____

_____

(3)
(Total 7 marks)

Q11.

The diagram shows the elements in Group 4 of the periodic table.

12	C
6	
28	Si
14	
73	Ge
32	
119	Sn
50	
207	Pb
82	

Carbon is a non- metal and silicon is usually considered to be a non- metal.

Tin and lead have all the usual properties of metals.

Germanium has these properties:

- grey-white shiny solid
- melting point 937°C
- semi-conductor
- reacts with chlorine to form the chloride ($GeCl_4$) which is a liquid molecular compound
- germanium oxide reacts with acids to form a salt solution and water. It also reacts with alkalis.

(a) With reference to their structure, explain why tin and lead are good conductors of electricity.

_____

_____

_____

_____

_____

_____

(3)

(b) Would you classify germanium as a metal or as a non-metal? Give your reasons.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q12.

Atoms of calcium, phosphorus and fluorine are represented below, each with its mass number and proton number.

40	31	19	← mass numbers
Ca	P	F	
20	15	9	← proton numbers

(a) Use this information to complete the table.

	CALCIUM	PHOSPHORUS	FLUORINE
Number of protons in the nucleus	20		9
Number of neutrons in the nucleus	20	16	
Number of electrons		15	9

(3)

(b) Calcium and fluorine atoms can combine to form the compound calcium fluoride, CaF_2.

The fluoride ion is represented by F^-.

(i) Explain how the fluorine atom forms a fluoride ion.

_____

_____

(2)

(ii) How is the calcium ion represented?

_____

(2)

(c) Phosphorus and fluorine form a covalent compound, phosphorus trifluoride.

Complete the sentences below which are about this compound.

Phosphorus trifluoride is made up of phosphorus and fluorine _____

These are joined together by sharing pairs of _____ to form

phosphorus trifluoride _____ .

(3)

(d) (i) Sodium chloride, an ionic compound, has a high melting point whereas paraffin wax, a molecular compound, melts easily.

Explain why.

_____

_____

_____

_____

(2)

(ii) Molten ionic compounds conduct electricity but molecular compounds are non-conductors, even when liquid.

Explain why.

_____

_____

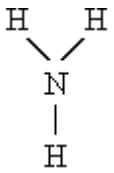
_____

(2)

(Total 14 marks)

Q13.

The diagram shows one molecule of the compound ammonia.



Write down everything that the diagram tells you about each molecule of ammonia.

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q14.

Here is a symbol equation, with state symbols, for a chemical reaction between solutions of lead nitrate and potassium chloride.

$$Pb(NO_3)_{2\,(aq)} + 2\,KCl_{(aq)} \longrightarrow 2KNO_{3\,(aq)} + PbCl_{2\,(s)}$$

The equation tells you the formulae of the two products of the reaction.

(a) What are the names of the **two** products?

1. _____

2. _____

(2)

(b) What else does the equation tell you about these products?

_____

_____

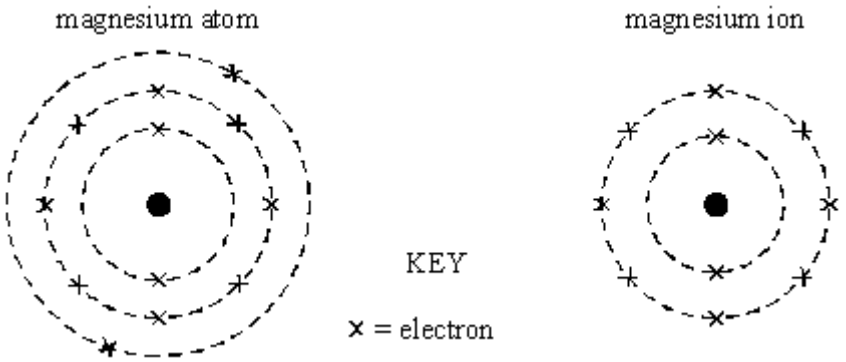
_____

(2)

(Total 4 marks)

Q15.

(a) The diagrams below show the electronic structure of a magnesium atom and a magnesium ion.



What is the charge on the magnesium ion? _____

(2)

(b) Calcium bromide has the formula $CaBr_2$.

What does this tell you about the ions in this compound?

_____

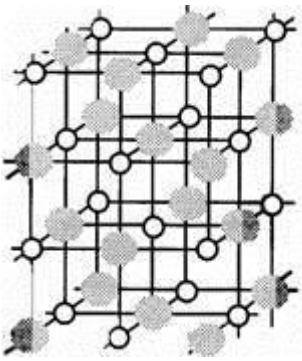
_____

(2)

(Total 4 marks)

Q16.

The diagrams show the giant structures of sodium chloride and diamond.



sodium chloride (melting point 801°C) diamond (melting point 4800°C)

(a) The equation shows how sodium choride could be formed.

Balance the equation.

$$Na + Cl_2 \rightarrow Na\,Cl$$

(1)

(b) By reference to the detailed structure of sodium chloride explain fully why:

(i) sodium chloride has a quite high melting point,

_____

_____

_____

_____

(1)

(ii) solid sodium chloride melts when it is heated strongly,

_____

_____

(2)

(iii) molten sodium chloride will conduct electricity.

_____

_____

(1)

(c) By reference to the detailed structure of diamond, explain why the melting point of diamond, is higher than that of sodium chloride.

_____

_____

_____

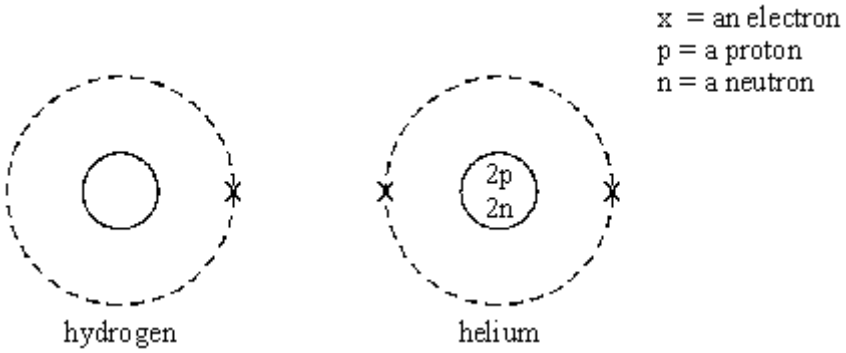
_____

_____

(2)
(Total 7 marks)

Q17.

(a) The diagrams represent the atomic structures of two gases, hydrogen and helium.



Hydrogen gas is made up of diatomic molecules (molecules with two atoms).
Helium gas exists as single atoms.

(i) How is a molecule of hydrogen formed from two hydrogen atoms?
(You may use a diagram as part of your answer)

_____

_____

_____

(2)

(ii) Why does helium exist only as single atoms?

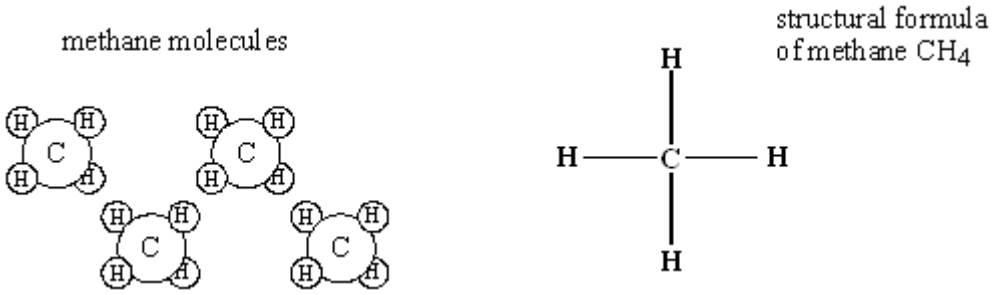
_____

_____

_____

(2)

(b) Hydrogen combines with carbon to form methane.
Each molecule contains four hydrogen atoms strongly bonded to a carbon atom.



Explain why methane has a low boiling point.

_____

_____

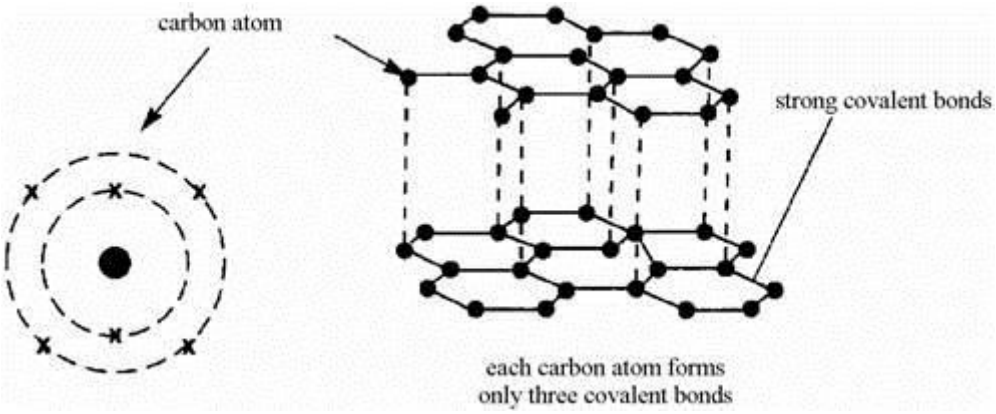
(2)
(Total 6 marks)

Q18.

(a) Copper is a metal.
Explain how it conducts electricity.

(2)

(b) Graphite is a non-metal.



Use the information to explain why graphite conducts electricity.

(3)
(Total 5 marks)