1 Follow the steps to find the percentage of iron in iron oxide.

Relative atomic masses: O 16; Fe 56.

(i) Step 1

Calculate the relative formula mass of iron oxide, Fe_2O_3.

.....

.....

(1)

(ii) Step 2

Calculate the total relative mass of just the iron atoms in the formula, Fe_2O_3.

.....

(1)

(iii) Step 3

Calculate the percentage (%) of iron in the iron oxide, Fe_2O_3.

.....

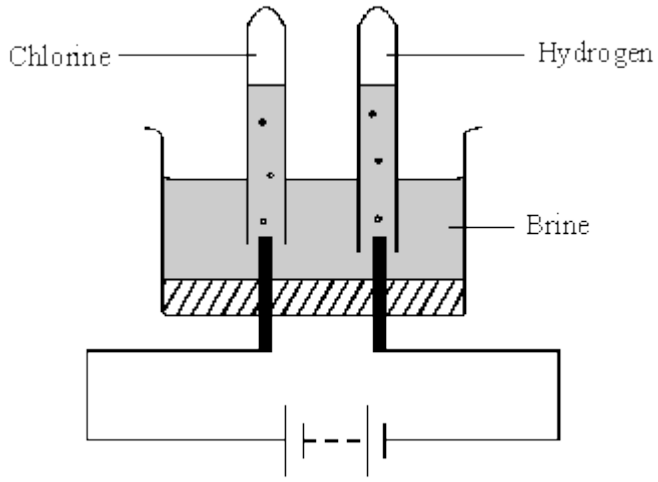
.....

Percentage of iron ..... %

(1)

(Total 3 marks)

2 Brine, a solution containing sodium chloride in water, can be used to manufacture chlorine, hydrogen and sodium hydroxide. A student sets up a simplified model of the industrial cell.



(a) The electron arrangements of some atoms are shown here.

H 1

O 2.6

Na 2.8.1

C1 2.8.7

(i) Use the relevant electron arrangements to describe the bonding in water.

.....

.....

.....

.....

.....

.....

(2)

(ii) Use the relevant electron arrangements to describe the bonding in sodium chloride.

.....

.....

.....

.....

.....

.....

(3)

(b) Use the atomic structures of $^{35}_{17}Cl$ and $^{37}_{17}Cl$ to explain the meaning of the term *isotopes*.

.....

.....

.....

.....

.....

.....

(3)

(Total 8 marks)

3 This question is about sodium chloride (common salt) which is an important chemical.

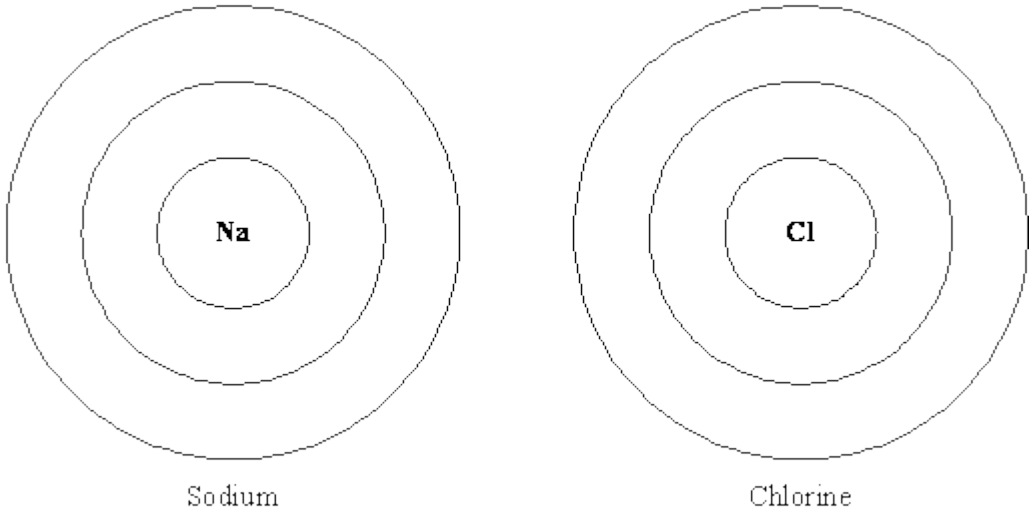
Sodium chloride can be made by burning sodium in chlorine gas.

(a) Balance the symbol equation for the reaction of sodium with chlorine.

$$Na_{(s)} + Cl_{2(g)} \rightarrow NaCl_{(s)}$$

(1)

(b) (i) Complete the diagrams below to show the electronic structures of a sodium and a chlorine atom. (Atomic number of sodium = 11 and chlorine = 17.)



(3)

(ii) When sodium reacts with chlorine the sodium atoms are changed into sodium ions (Na^+) and the chlorine atoms are changed into chlorine ions (Cl^-).

Explain how:

1. a sodium atom changes into a sodium ion;

.....

.....

(2)

2. a chlorine atom changes into a chloride ion.

.....

.....

(2)

(c) The element potassium is in the same group of the Periodic Table as sodium. Potassium reacts with chlorine to make potassium chloride which is sometimes used instead of common salt in cooking.

(i) Predict the formula of potassium chloride.

.....

(1)

By reference to the electronic structures of potassium and sodium explain:

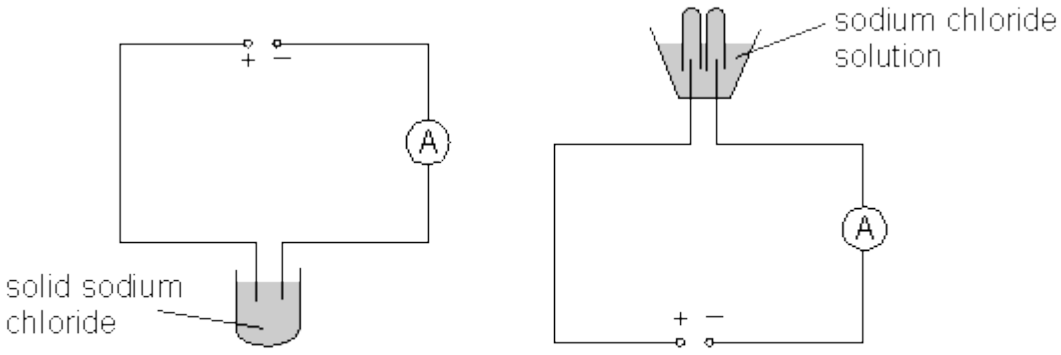
(ii) Why the reaction of potassium with chlorine is similar to the reaction of sodium with chlorine.

.....

.....

(1)

(d) The electrolysis of sodium chloride solution is an important industrial process. The diagrams below show two experiments set up during an investigation of the electrolysis of sodium chloride.



Experiment 1 Experiment 2

(i) What would be the reading on the ammeter in experiment 1?

..... A

(ii) Explain your answer.

.....

.....

.....

(3)

(e) The equations below show the reactions which take place in experiment 2.

$$H_2O_{(1)} \rightarrow H^+_{(aq)} + OH^-_{(aq)}$$

$$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$$

$$2Cl^-_{(aq)} - 2e^- \rightarrow Cl_{2(g)}$$

(i) Which substance provides hydrogen ions?

.....

(1)

(ii) Name the product formed at:

(A) the positive electrode;

.....

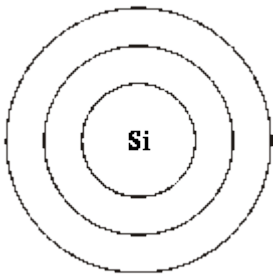
(B) the negative electrode.

.....

(1)
(Total 15 marks)

4 Silicon is an extremely important element. More than a million tonnes of silicon are produced each year. Silicon is made by reducing silicon oxide (sand) with carbon (coke).

(a) (i) Complete the diagram below to show the arrangement of electrons in an atom of silicon. The Data Sheet may help you with this question.



(2)

(ii) Which electrons in the silicon atom take part in chemical reactions with other atoms?

.....

.....

(1)

(iii) What features of all the atoms of the elements in group 4 of the Periodic Table might give them similar chemical properties?

.....

.....

(1)

(b) Silicon is difficult to classify as a metal or a non-metal because it has properties which resemble both. Some of the properties of silicon are listed below.

- Silicon is a shiny blue/grey solid.
- Silicon is placed in Group 4 of the Periodic Table.
- Silicon has a relative atomic mass of 28.
- Silicon has a very high melting point (1410ºC).
- Silicon has a very high boiling point (2355ºC).
- Silicon conducts electricity.
- Silicon oxide will neutralise alkalis.
- Silicon forms compounds in which the silicon atoms are bonded to other atoms by covalent bonds.

(i) Select **two** properties from the list above in which silicon resembles a metal.

1. .....

2. .....

(2)

(ii) Select **two** properties from the list above in which silicon resembles a non-metal.

1. .....

2. .....

(2)
(Total 8 marks)

5 Limestone ($CaCO_3$) is a raw material. On strong heating it is converted to calcium oxide which is a very useful substance.

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

(a) Calculate the formula mass (M_r) of calcium carbonate.

.....

M_r of calcium carbonate = ...

(2)

(b) About 60 million tonnes of calcium oxide is made in Britain each year.
Calculate the mass of calcium carbonate needed to make this amount of calcium oxide.

.....

.....

.....

.....

.....

.....

Mass of calcium carbonate needed = ... million tonnes

(4)

(c) Water is added to some of the calcium oxide produced in a process known as 'slaking'. The product of this reaction is used to make plaster.

$CaO_{(s)} + H_2O_{(1)} \rightarrow Ca(OH)_{2(s)}$

(i) Give the chemical name of $Ca(OH)_2$.

.....

(1)

(ii) What is the physical state of the $Ca(OH)_2$ formed in the reaction?

.....

(1)

(Total 8 marks)

6 There are millions of different substances that make up our world. All these substances are made from chemical elements.

(a) What is an element?

.....

.....

.....

.....

(1)

(b) Many substances are compounds. What is a compound?

.....

.....

.....

.....

(2)

(Total 3 marks)

7 Use the Periodic Table on the Data Sheet to help you to answer this question.

(a) State **one** similarity and **one** difference in the electronic structure of the elements:

(i) across the Period from sodium to argon;

.....

.....

.....

(2)

(ii) down Group 7 from fluorine to astatine.

.....

.....

.....

(2)

(b) (i) State the trend in reactivity of the Group 1 elements.

.....

(1)

(ii) Explain this trend in terms of atomic structure.

.....

.....

.....

.....

.....

(3)

(c) Hydrogen is an element which is difficult to fit into a suitable position in the Periodic Table. Give reasons why hydrogen could be placed in either Group 1 or Group 7.

.....

.....

.....

.....

.....

.....

(3)

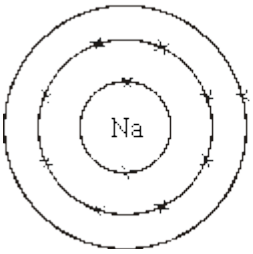
(Total 11 marks)

8 (a) The electronic structure of a sodium atom can be written 2,8,1.
Write the electronic structure of a potassium atom in the same way.

.....

(1)

(b) The electronic structure of a sodium atom can also be represented as in the diagram below.



(i) Draw a similar diagram for a fluorine atom.

(ii) Draw similar diagrams to show the electronic structure of the particles in sodium fluoride.

(4)
(Total 5 marks)

9 The following passage was taken from a chemistry textbook.

Germanium is a white, shiny, brittle element. It is used in the electronics industry because it is able to conduct a small amount of electricity.

It is made from germanium oxide obtained from flue dusts of zinc and lead smelters.
The impure germanium oxide from the flue dusts is changed into germanium by the process outlined below.

STEP 1 The germanium oxide is reacted with hydrochloric acid to make germanium tetrachloride. This is a volatile liquid in which the germanium and chlorine atoms are joined by covalent bonds.

STEP 2 The germanium tetrachloride is distilled off from the mixture.

STEP 3 The germanium tetrachloride is added to an excess of water to produce germanium oxide and hydrochloric acid.

STEPS 1 to 3 are repeated several times.

STEP 4 The pure germanium oxide is reduced by hydrogen to form germanium.

(a) Balance the equation below which represents the reaction in step 1.

GeO_2 + ... HCl → $GeCl_4$ + ... H_2O

(1)

(b) Write a word equation for the reaction in step 3.

.....

(1)

(c) Suggest why steps 1 to 3 are repeated several times.

.....

.....

(1)

(d) The equation which represents the reaction in step 4 is shown below.

$$GeO_2 + 2H_2 \rightarrow Ge + 2H_2O$$

(i) Explain what is meant by the term 'reduced'.

.....

.....

(1)

(ii) Calculate the mass of germanium which could be made from 525 g of germanium oxide. (Relative atomic masses: Ge = 73; O = 16).

.....

.....

.....

.....

Mass ..... g

(3)

(e) Germanium is difficult to classify as either a metal or a non-metal.

(i) Give as much evidence as you can from the information in this question to support the view that germanium is a metal. Explain your answer as fully as you can.

.....

.....

.....

.....

.....

(3)

(ii) Give as much evidence as you can from the information in this question to support the view that germanium is a non-metal. Explain your answer as fully as you can.

.....

.....

.....

.....

(3)
(Total 13 marks)

10 (a) The list below gives six substances.

- aluminium
- beer
- copper
- milk
- pure water
- sodium chloride

Put each substance in the correct column of the table.

ELEMENTS	COMPOUNDS	MIXTURES

(3)

(b) Elements can be divided into two groups, metals and non-metals.

The list below gives some properties of elements.

- brittle
- can be hammered into shape
- dull
- good conductors of electricity
- poor conductors of electricity
- shiny

Put each property into the correct column.

PROPERTIES OF METALS	PROPERTIES OF NON-METALS

(3)
(Total 6 marks)

11 Sando-K is a medicine. It is given to people whose bodies contain too little of a particular element.

Sando-K is a mixture of two compounds. The formulae of the two compounds are given below.

$KHCO_3$ **KCl**

(a) Use the Data Sheet to help you to name all the elements in these compounds.

.....

.....

.....

.....

(3)

(b) Which metal do people given Sando-K need?

.....

(1)
(Total 4 marks)

12 Sando-K is a medicine. It is given to people whose bodies contain too little of a particular element.

Sando-K is a mixture of two compounds. The formulae of the two compounds are given below.

$KHCO_3$ **KC1**

(a) Which metal do people given Sando-K need?

.....

(1)

(b) Sando-K contains the ion, CO_3^{2-}. Which gas would be produced if a dilute acid was added to Sando-K? (The Data Sheet may help you to answer this question.)

.....

(1)

(c) The compounds in Sando-K contain ions.

Complete the two sentences below.

Atoms change into positive ions by ..... one or more

..... .

Atoms change into negative ions by ..... one or

more ..... .

(4)

(d) Electricity can be used to show that an aqueous solution of Sando-K contains ions.

(i) Draw a diagram of an apparatus that you could use to prove that Sando-K contains ions.

(4)

(ii) Explain, as fully as you can, what would happen when the electricity is switched on.

.....

.....

.....

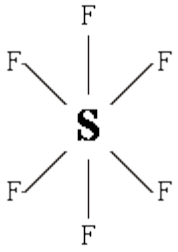
.....

(3)

(Total 13 marks)

13 Sulphur hexafluoride is a colourless, odourless, non-flammable gas, which is insoluble in water and extremely unreactive. It is used as an insulator in high voltage transformers and switchgear.

The diagram below represents a molecule of sulphur hexafluoride.



(a) What type of chemical bond holds the sulphur and fluorine atoms together in sulphur hexafluoride molecules?

.....

(1)

(b) Explain why sulphur hexafluoride has a low boiling point.

.....

.....

(2)

(c) Explain how **three** of the properties of sulphur hexafluoride make it suitable for use as an insulator inside electrical transformers.

Property 1: .....

Explanation: .....

.....

Property 2: .....

Explanation: .....

.....

Property 3: .....

Explanation: .....

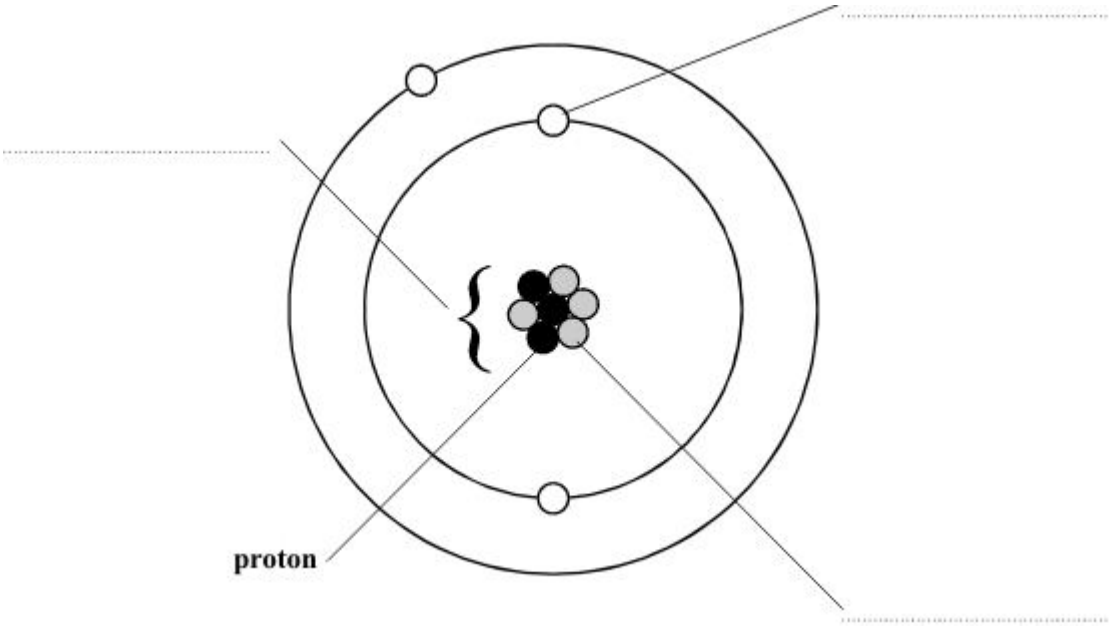
.....

(3)

(Total 6 marks)

14 The diagram represents an atom. Choose words from the list to label the diagram.

electron **ion** **neutron** **nucleus**



(Total 3 marks)

15 Use these relative atomic masses: H = 1; O = 16; Ca = 40
to calculate the relative formula mass *(M_r)* of

quicklime CaO .....

slaked lime $Ca(OH)_2$ .....

(Total 2 marks)

16 One definition of an element is:

"A substance that cannot be broken down into simpler substances by chemical methods"

The table below shows some of the 'substances' which Antoine Lavoisier thought were elements. He divided the 'substances' into four groups. He published these groups in 1789.

The modern names of some of the 'substances' are given in brackets.

ACID-MAKING ELEMENTS	GAS-LIKE ELEMENTS	METALLIC ELEMENTS		EARTHY ELEMENTS
sulphur	light	cobalt	mercury	lime (calcium oxide)
phosphorus	caloric (heat)	copper	nickel	magnesia (magnesium oxide)
charcoal (carbon)	oxygen	gold	platina (platinum)	barytes (barium sulphate)
	azote (nitrogen)	iron	silver	argilla (aluminium oxide)
	hydrogen	lead	tin	silex (silicon dioxide)
		magnese	tungsten	
		zinc		

(a) Name **one** 'substance' in the list which is **not** a chemical element or compound.

.....

(1)

(b) (i) Name **one** substance in the list which is a compound.

.....

(1)

(ii) Suggest why Lavoisier thought that this substance was an element.

.....

.....

.....

.....

(1)

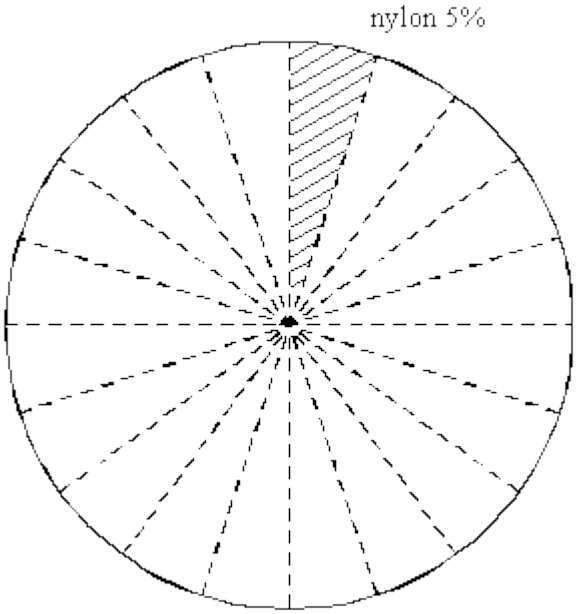
(Total 3 marks)

17 Ammonia is a very important chemical.

(a) The table shows the percentage of ammonia used to make different substances.

SUBSTANCES MADE FROM AMMONIA	PERCENTAGE (%) OF AMMONIA USED
fertilisers	75
nitric acid	10
nylon	5
others	10

Shade on the pie chart the percentage of ammonia used to make nitric acid.



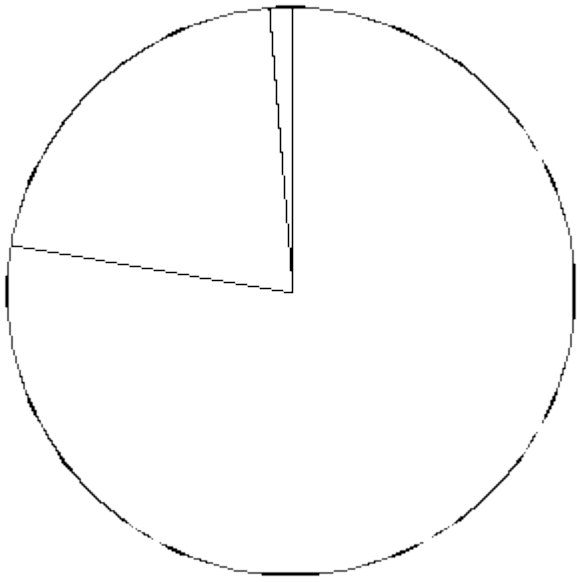
(1)

(b) Ammonia gas is made by the reaction between nitrogen gas and hydrogen gas.
Write a word equation to represent this reaction.

..... + ... ⇌ .....

(1)

(c) Nitrogen is one of the raw materials used to make ammonia.
Nitrogen is obtained from air.
This pie chart shows the proportion of nitrogen, oxygen and other gases in air.
Label the area which represents the proportion of nitrogen in air.



(1)

(d) An artificial fertiliser contains compounds with the formulae:

NH_4NO_3 and **KCl**

(i) Use the Data Sheet to help you answer this question.
Name the elements in the compound NH_4NO_3.

1 .....

2 .....

3 .....

(2)

(ii) Use the Data Sheet to help you answer this question.
Name the compound KCl.

.....

(1)

(e) (i) Ammonium nitrate is one type of artificial fertiliser.
Calculate the relative formula mass of ammonium nitrate NH_4NO_3.
(Relative atomic masses: H = 1, N = 14, O = 16.)

.....

.....

(1)

(ii) Use your answer to part (f)(i) to help you calculate the percentage by mass of nitrogen present in ammonium nitrate NH_4NO_3.

.....

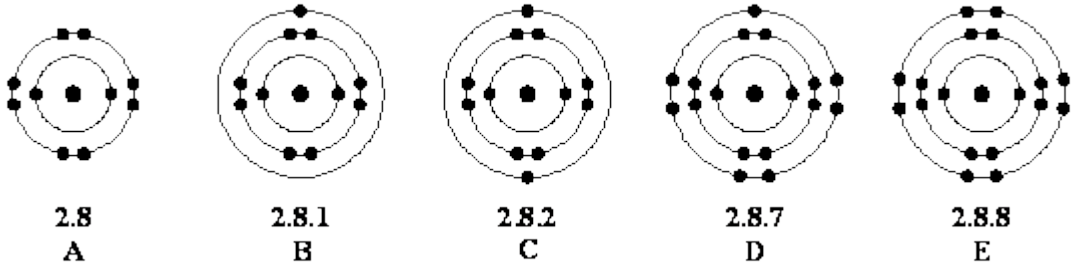
.....

.....

(2)
(Total 9 marks)

18 Use the Data Sheet to help you answer this question.

When sodium reacts with water it forms sodium ions.
The diagrams below represent the electron arrangements of some atoms and ions.



Which of the diagrams, **A** to **E**, represents the electron arrangement of each of the following?

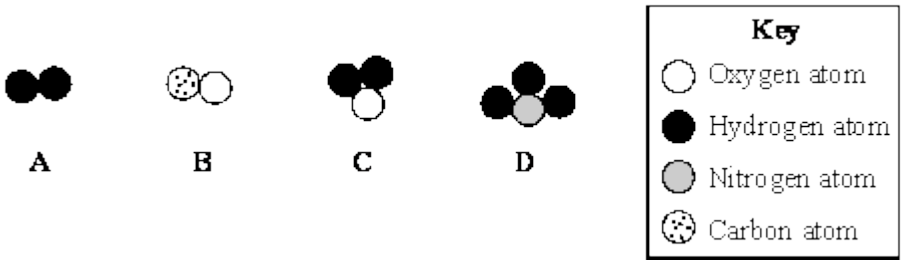
(i) A sodium atom, Na .....

(ii) A sodium ion, Na^+ .....

(Total 2 marks)

19 The periodic table on the Data Sheet might help you to answer this question.

Diagrams **A – D** show models of four different molecules.



Complete the table to give the name and the formula of each of the molecules **A – D**.

The first one has been done for you.

Molecule	Name	Formula
A	Hydrogen	H_2
B		
C		
D		

(Total 6 marks)

20 (a) You may find the Data Sheet helpful to complete the word equation.

These two gases react as shown in the balanced symbol equation.

$$2H_2 + O_2 \rightarrow 2H_2O$$

Complete the word equation for this reaction.

hydrogen + ... → .....

(2)

(b) Complete this sentence by crossing out the **two** words in the box that are wrong.

This chemical reaction is much faster if a molecule if a

catalyst
molecule
solution

is used.

(1)
(Total 3 marks)

21 Use the Periodic Table of Elements on the Data Sheet to help you to answer this question.

(a) Describe, in as much detail as you can, the structure of a fluorine atom.

.....

.....

.....

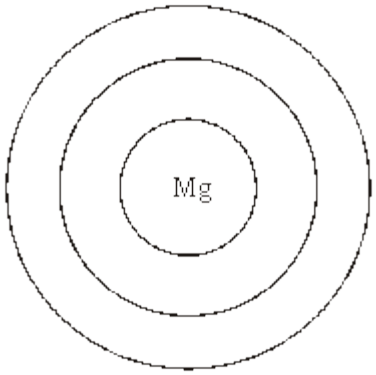
.....

.....

.....

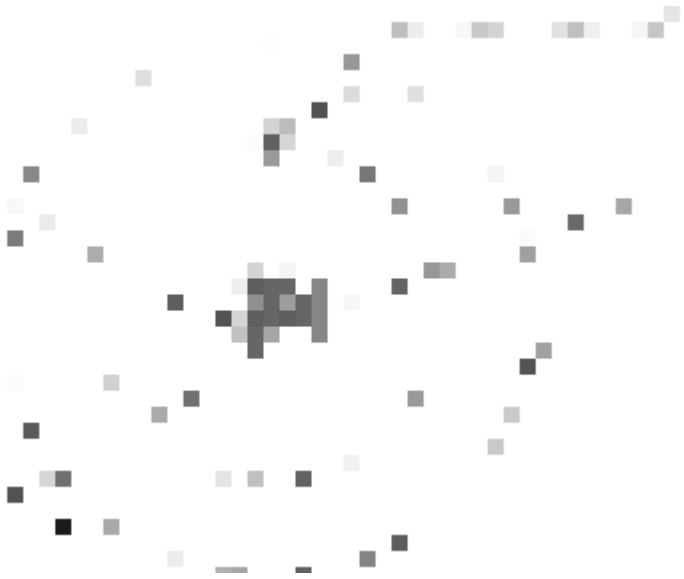
(3)

(b) Complete the diagram to show the electronic structure of a magnesium atom.



(1)
(Total 4 marks)

22 The diagram shows an atom.



(a) On the diagram, write the names of structures **A**, **B**, **C** and **D**.

(4)

(b) To which Group of the periodic table does this atom belong?

.....

Give **one** reason for your answer.

.....

.....

(2)

(c) Name the element which is made up of this type of atom.

.....

(1)

(Total 7 marks)

23 Ammonium chloride, NH_4Cl, is made up of nitrogen, hydrogen and chlorine atoms.

(i) Complete the table to show the number of atoms of each element present in NH_4Cl.

Element	**Number of atoms in NH_4Cl**
nitrogen	1
hydrogen	
chlorine	

(1)

(ii) Calculate the relative formula mass of ammonium chloride, NH_4Cl.

(Relative atomic masses: H = 1, N = 14, Cl = 35.5)

.....

.....

.....

.....

Relative formula mass = ...

(2)

(Total 3 marks)

24 Electrons, neutrons and protons are sub-atomic particles.

(a) Complete the **six** spaces in the following table.

Name of sub-atomic particle	Relative mass	Relative charge
.....	1	.....
.....	.....	0
.....	$\frac{1}{1840}$	.....

(3)

(b) An aluminium atom has 13 electrons. How are these arranged in shells around the nucleus?

.....

(1)

(c) Chromium atoms have 24 protons and 28 neutrons.

(i) How many electrons does each neutral chromium atom have?

.....

(1)

(ii) What is the mass number of chromium?

.....

(1)

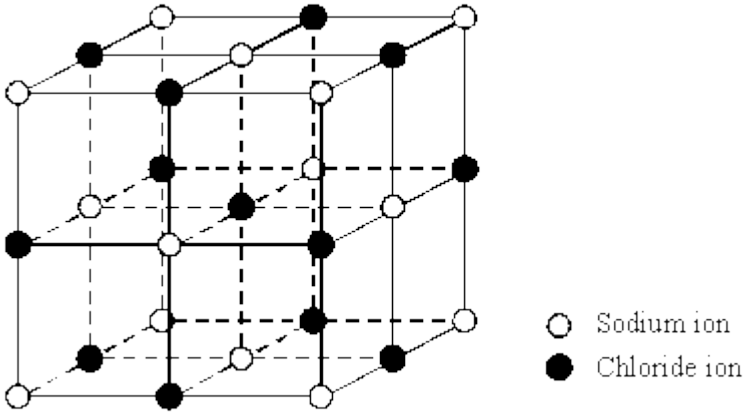
(d) What change occurs to an atom which undergoes the process of *reduction* in a chemical reaction?

.....

.....

(1)

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



Explain why the ions in this lattice stay in place.

.....

.....

.....

.....

.....

.....

(3)

(Total 10 marks)

25 (a) Atoms are made of sub-atomic particles. Complete the **six** spaces in the table.

Name of sub-atomic particle	Relative mass	Relative charge
.....	$\frac{1}{1840}$	.....
Neutron	.....	.....
.....	1	.....

(3)

(b) Complete the spaces in the sentences.

(i) The atomic number of an atom is the number of ..... in its nucleus and is equal to the number of ..... if the atom is not charged.

(1)

(ii) The mass number of an atom is the total number of ..... and ..... in its nucleus.

(1)

(c) The table gives information about the atoms of three elements.

Name of element	Chemical symbol	Number of electrons in:		
		1st shell	2nd shell	3rd shell
Fluorine	F	2	7	0
Neon	Ne	2	8	0
Sodium	Na	2	8	1

Two of these elements can react together to form a chemical compound.

(i) What is the name and the formula of this compound?

Name ..... Formula .....

(2)

(ii) What type of bonding holds this compound together?

.....

(1)

(iii) Explain, in terms of electron transfer, how the bonding occurs in this compound.

.....

.....

.....

.....

.....

.....

(2)
(Total 10 marks)

26 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 .....

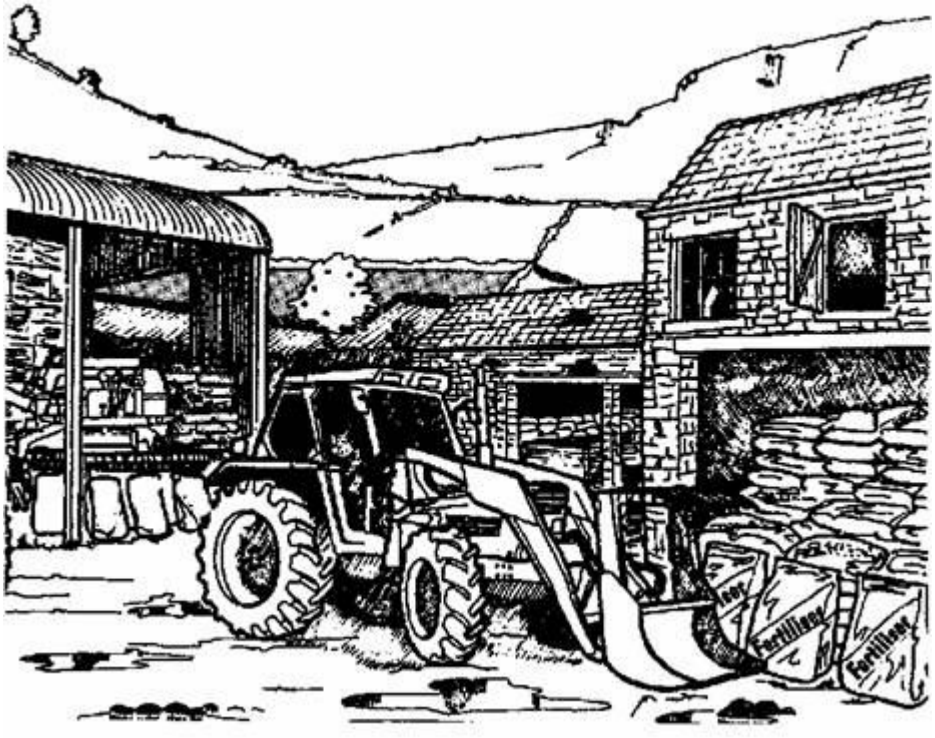
.....

Property 3 .....

.....

(3)
(Total 7 marks)

27 Ammonium nitrate and ammonium sulphate are used as fertilisers.



(i) Which acid reacts with ammonia to form ammonium nitrate?

.....

(1)

(ii) Which acid reacts with ammonia to form ammonium sulphate?

.....

(1)

(iii) The reactions in (i) and (ii) are both exothermic. How can you tell that a reaction is exothermic?

.....

.....

(1)

(iv) The reactions in (i) and (ii) are both examples of acid + base reactions. What is the name of the chemical change which takes place in every acid + base reaction?

.....

(1)
(Total 4 marks)

28 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)

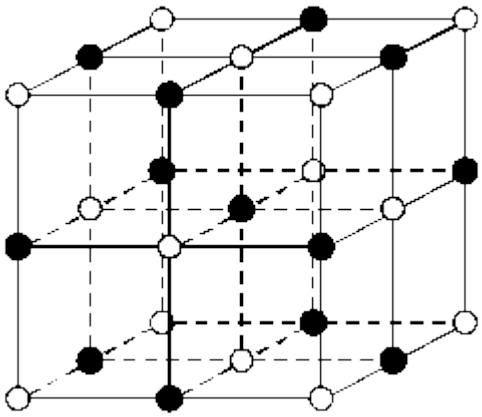
(ii) State why the formation of sodium ions is classified as an oxidation.

.....

.....

(1)
(Total 6 marks)

29 (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.

.....

.....

.....

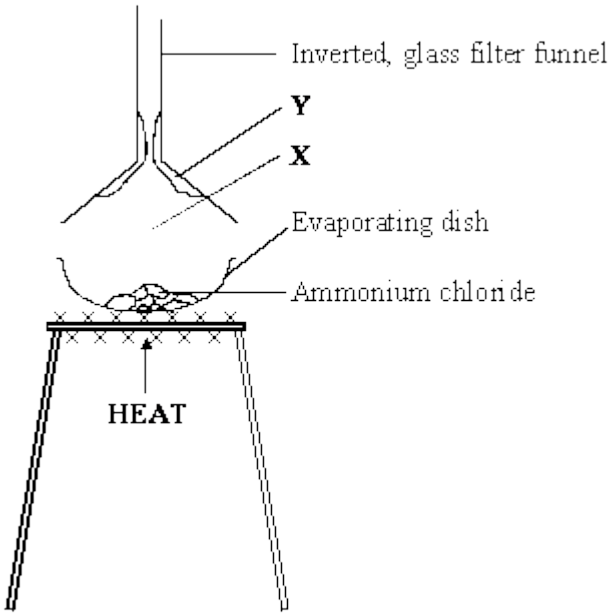
.....

(2)
(Total 10 marks)

30 (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)

31 Choose words from this list to complete the sentences below.

carbonate **chloride** **compound** **mixture** **oxide** **solution**

(a) When two elements react, the new substance formed is called a ..... .

(1)

(b) The white powder formed when zinc reacts with oxygen is called zinc ..... .

(1)

(Total 2 marks)

32 The two carbon atoms represented below are isotopes.

ISOTOPE 1		ISOTOPE 2
14	mass number	12
C		C
6	proton number	6

(a) Describe **two** ways in which the isotopes are similar.

.....

.....

(2)

(b) Describe as fully as you can **one** way in which they are different.

.....

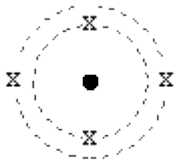
.....

.....

(2)

(Total 4 marks)

33 (a) The diagram shows the electronic structure of a particular element.



In a similar way, show the electronic structure of another element from the same group in the periodic table and name the element you select.

Name of element selected .....

(4)

(b) The element lithium gives a moderate reaction with cold water, releasing hydrogen and forming a solution of lithium hydroxide.

Describe how sodium is similar to and how it is different from lithium in its chemical reaction with cold water.

Explain any similarity or difference in terms of their atomic structure.

Similarity. .....

Reason. .....

.....

.....

Difference. .....

Reason. .....

.....

.....

(5)
(Total 9 marks)

34 (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)
(Total 4 marks)

35 Sodium carbonate reacts with acids.

(i) Complete the word equation.

sodium carbonate + hydrochloric acid → sodium chloride + ... + water

(1)

(ii) Name the salt produced if sodium carbonate reacts with dilute nitric acid.

.....

(1)
(Total 2 marks)

36 (a) The formula for ammonia is NH_3. What does the formula tell you about each molecule of ammonia?

.....

.....

.....

.....

(3)

(b) Ammonia is used to make nitric acid (HNO_3). Calculate the formula mass (Mr) for nitric acid. (Show your working).

.....

.....

.....

.....

.....

(3)
(Total 6 marks)

37 (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.

.....

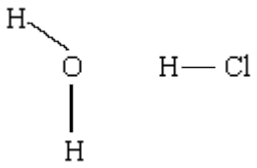
.....

.....

.....

(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)

38 You will find it helpful to use the information on the Data Sheet when answering this question.

In the nucleus of an aluminium atom are:

13 protons
and 14 neutrons.

(a) Complete these sentences.

(i) The mass number of the aluminium atom is ..... .

(ii) In an atom of aluminium there are ..... electrons.

(2)

(b) Why is an aluminium atom electrically neutral?

.....

.....

.....

(2)

(c) Complete the table for the element fluorine.

PARTICLE	NUMBER OF PROTONS	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
Fluorine atom	9		9
Fluoride atom		10	

(3)
(Total 7 marks)

39 The formula for the compound hydrogen peroxide is H_2O_2.

Write down everything that the formula tells you about each molecule of hydrogen peroxide.

.....

.....

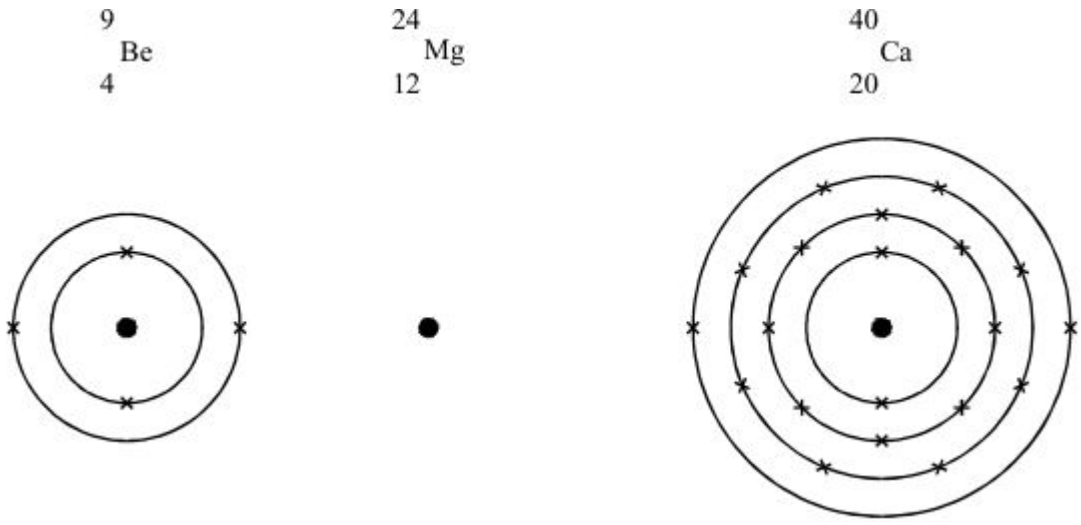
.....

.....

.....

(Total 4 marks)

40 Three elements in Group 2 of the periodic table are beryllium (Be), magnesium (Mg) and calcium (Ca). Their mass numbers and proton numbers are shown below. The electronic structure is shown for beryllium and calcium.



(a) In a similar way, draw the electronic structure for magnesium.

(3)

(b)
- The three elements have similar chemical properties
- The reactivity of these elements with non-metals, increases from beryllium to magnesium to calcium.

Explain these two statements in terms of atomic structure.

.....

.....

.....

.....

.....

.....

(6)
(Total 9 marks)

41 The information on the Data Sheet will be helpful in answering this question.

(a) Calculate the formula mass (M_r) of the compound iron (III) oxide, Fe_2O_3.

(Show your working.)

.....

.....

.....

.....

.....

(3)

(b) Calculate the mass of iron produced when 32g of iron (III) oxide is completely reduced by aluminium.

The reaction is shown in the symbol equation:

$$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$$

(Show your working.)

.....

.....

.....

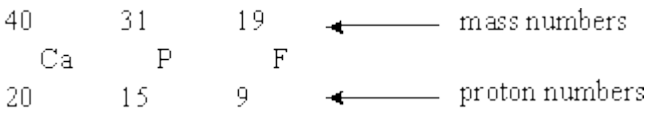
.....

Answer = ... grams

(3)

(Total 6 marks)

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



(a) Use this information to complete the table.

	CALCIUM	PHOSPHOROUS	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.

.....

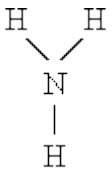
.....

.....

(2)

(Total 14 marks)

43 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)

44 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?

.....

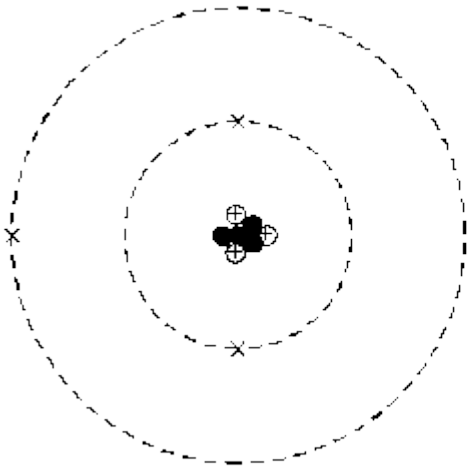
.....

.....

(2)

(Total 4 marks)

45 The diagram shows the structure of a lithium atom.



(a) (i) What is represented by ●.....

(ii) What is represented by  .....

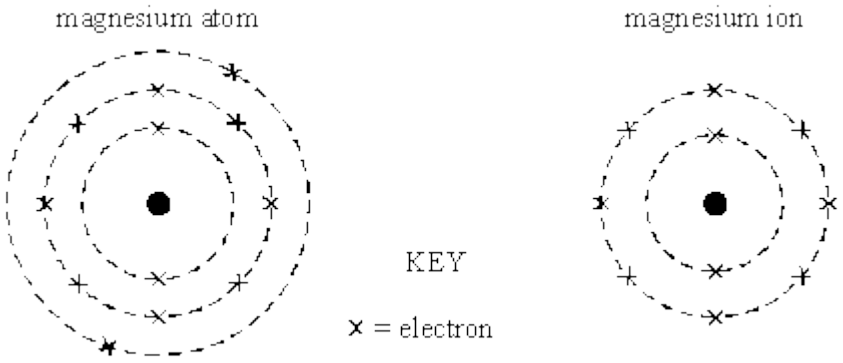
(2)

(b) What is the symbol for lithium? .....

(1)

(Total 3 marks)

46 (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)

47 These are the electronic structures of the atoms of three different elements.

2.8.1	2.8.8	2.8.8.1
element A	element B	element C

(a) Identify elements A and B.

Element A is .....

Element B is .....

(2)

(b) (i) Why is element C more reactive than element A?

.....

.....

.....

.....

.....

.....

(2)

(ii) Why is element B unreactive?

.....

.....

.....

(2)

(Total 6 marks)

48 (a) The formula for the chemical compound magnesium sulphate is $MgSO_4$.

Calculate the relative formula mass (M_r)of this compound. (Show your working.)

.....

.....

.....

.....

(2)

(b) Magnesium sulphate can be made from magnesium and dilute sulphuric acid.

This is the equation for the reaction.

$$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$$

Calculate the mass of magnesium sulphate that would be obtained from 4g of magnesium. (Show your working.)

.....

.....

.....

.....

.....

.....

Answer..... g

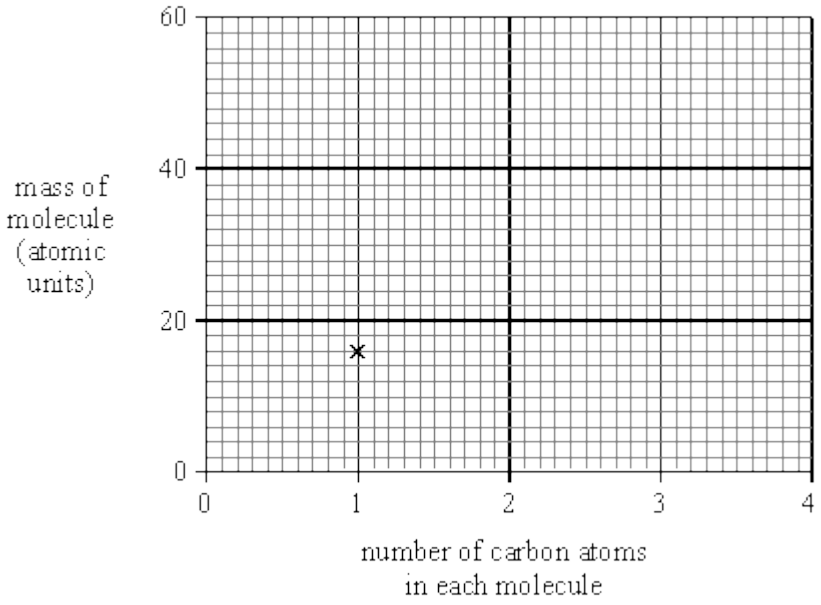
(2)

(Total 4 marks)

49 The table gives some information about a family of molecules in crude oil.

NUMBER OF CARBON ATOMS IN MOLECULE	MASS OF MOLECULE (atomic units)
1	16
2	30
4	58

(a) Show information from the table in the most appropriate way on the grid.



(3)

(b) What is the mass of a molecule with three carbon atoms?

.....

(1)

(c) The other atoms in each molecule are all hydrogen atoms.
What family of substances do all the molecules belong to?

.....

(1)

(d) The mass of a carbon atom is 12 atomic units.
The mass of a hydrogen atom is 1 atomic unit.

So the molecule with one carbon atom has four hydrogen atoms.
Its formula is CH_4.

Write down the formula:

(i) of the molecule with two carbon atoms .....

(ii) of a molecule from the same family with five carbon atoms .....

(2)

(Total 7 marks)

50 This question is about the structure of atoms.

(a) Choose words from the list to complete the sentences below.

electrons ions neutrons protons

In an atom, the particles with a negative charge are called .....

Particles in the nucleus with no charge are called .....

An atom has no overall charge because is has the same number of electrons and

.....

(3)

(b) Two isotopes of the element carbon are:

$^{12}_{6}C$ and $^{14}_{6}C$

Complete the table of information for these two isotopes.

	ATOMIC NUMBER	MASS NUMBER	NUMBER OF PROTONS	NUMBER OF NEUTRONS
Isotope $^{12}_{6}C$	6	12	6	6
Isotope $^{12}_{6}C$	6		6	

(2)
(Total 5 marks)

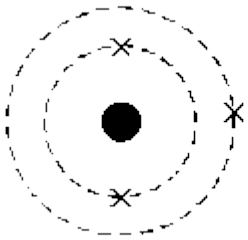
51 (a) Write down the symbols for

lithium .....

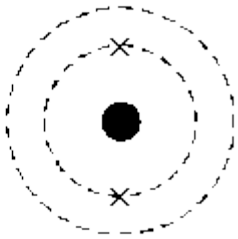
fluorine .....

(2)

(b) The electronic structure of a lithium atom can be shown like this:

2,1 or  where **x** is an electron.

In a similar way, complete this diagram to show the electronic structure of a fluorine atom.

2,7 or 

(1)

(c) A lithium atom can lose one electron to form a lithium ion which can be written **$(2)^+$**
A fluorine atom can gain one electron to form a fluoride ion.

Choose from the list the correct way to write the fluoride ion.

$(2,6)^+$ **$(2,7)^+$** **$(2,7)^-$** **$(2,8)^+$** **$(2,8)^-$**

Answer .....

(2)
(Total 5 marks)