

1

Distress flares are used to attract attention in an emergency.



Flares often contain magnesium. Magnesium burns to form magnesium oxide.

- (a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

Complete the following sentence using the correct words from the box.

gives out heat

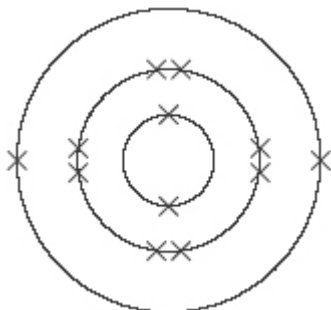
stores heat

takes in heat

An *exothermic* reaction is one which .....

(1)

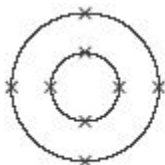
- (b) The diagram shows the electronic structure of a magnesium atom.  
The atomic (proton) number of magnesium is 12.



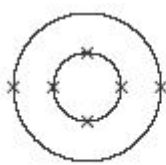
**Magnesium atom**

The atomic (proton) number of oxygen is 8.

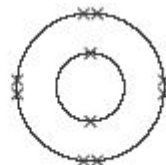
Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?



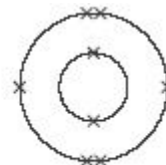
**A**



**B**



**C**

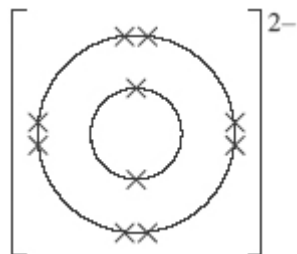


**D**

Diagram .....

(1)

- (c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen. The diagram shows the electronic structure of an oxide ion.



Oxide ion

Which diagram, **J**, **K**, **L** or **M**, shows the electronic structure of a magnesium ion?

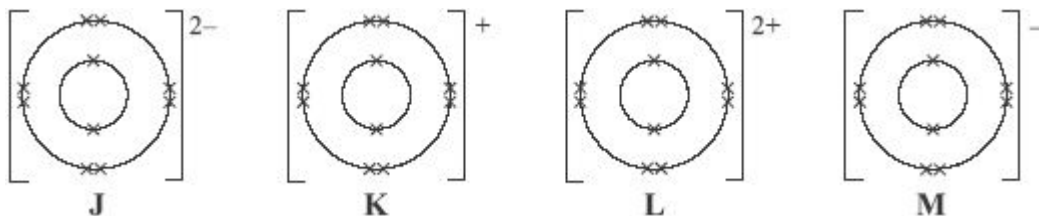


Diagram .....

(1)

- (d) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Draw a ring around the name of the salt formed when magnesium oxide reacts with hydrochloric acid.

**magnesium chloride**      **magnesium hydroxide**      **magnesium sulfate**

(1)

(Total 4 marks)

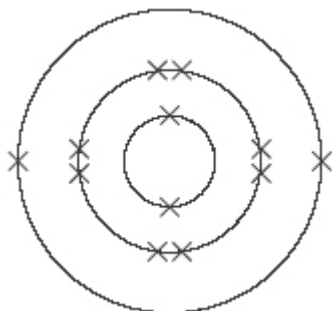
2

- (a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O<sub>2</sub>) to form magnesium oxide (MgO).

.....

(1)

- (b) The diagram shows the electronic structure of a magnesium atom.  
The atomic (proton) number of magnesium is 12.



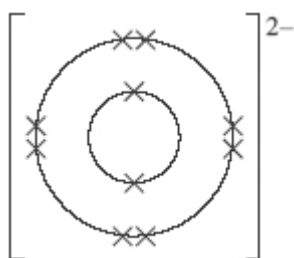
**Magnesium atom**

Draw a similar diagram to show the electronic structure of an oxygen atom.  
The atomic (proton) number of oxygen is 8.

(1)

- (c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

The diagram shows the electronic structure of an oxide ion.



**Oxide ion**

Draw a similar diagram to show the electronic structure of a magnesium ion.

(1)

(d) Magnesium oxide is a white solid with a high melting point.

Explain how the ions are held together in solid magnesium oxide.

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(2)

(e) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Complete the word equation for the reaction between magnesium oxide and hydrochloric acid.



(1)

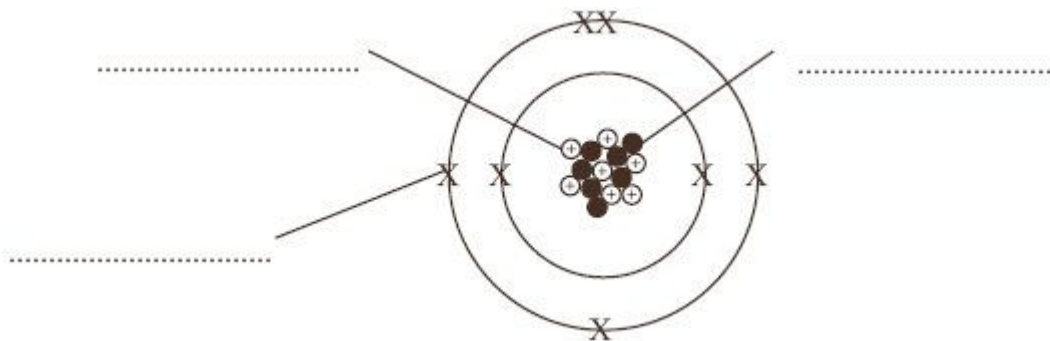
(Total 6 marks)

**3**

(a) The diagram represents an atom of nitrogen.

(i) Use words from the box to label the diagram.

electron	neutron	nucleus	proton
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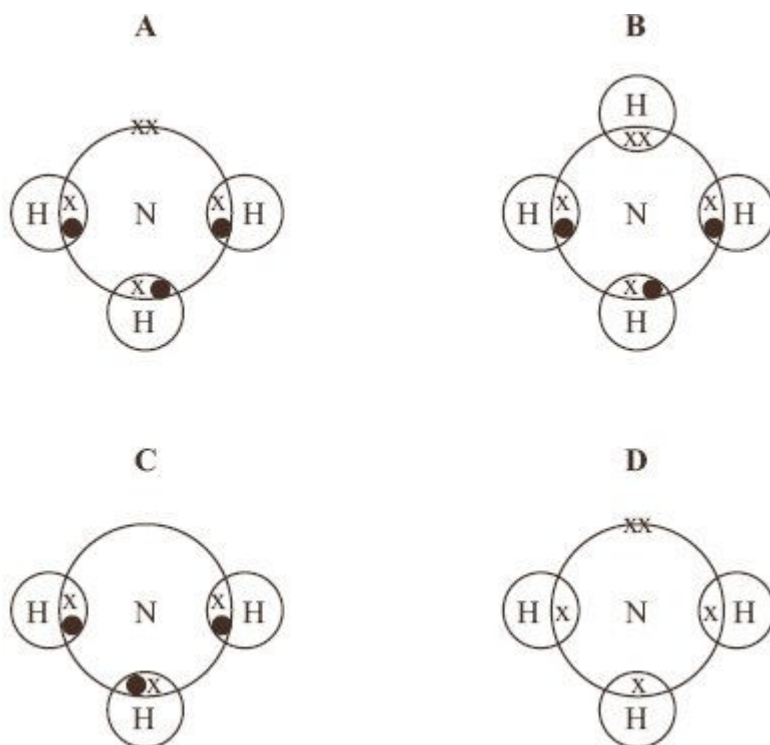
(2)

(ii) Draw a ring around the mass number of this atom.

5      7      14      21

(1)

(b) Nitrogen can react with hydrogen to make ammonia,  $\text{NH}_3$ .



Which diagram, **A**, **B**, **C** or **D**, best represents an ammonia molecule?

(1)  
(Total 4 marks)

4

Toothpastes often contain fluoride ions to help protect teeth from attack by bacteria.



Some toothpastes contain tin(II) fluoride.

This compound has the formula  $\text{SnF}_2$ .

(a) Calculate the relative formula mass ( $M_r$ ) of  $\text{SnF}_2$ .

Relative atomic masses: F = 19; Sn = 119

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.....

Relative formula mass ( $M_r$ ) = .....

**(2)**

(b) Calculate the percentage by mass of fluorine in  $\text{SnF}_2$ .

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Percentage by mass of fluorine = ..... %

**(2)**

(c) A tube of toothpaste contains 1.2 g of  $\text{SnF}_2$ .

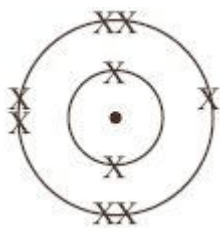
Calculate the mass of fluorine in this tube of toothpaste.

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Mass of fluorine = ..... g

**(1)**

- (d) The diagram represents the electron arrangement of a fluorine atom.



Explain how a fluorine atom can change into a fluoride ion,  $F^-$ .

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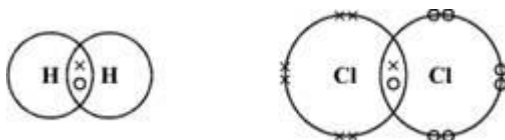
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(2)  
(Total 7 marks)

**5** Hydrogen chloride (HCl) can be made by the reaction of hydrogen ( $H_2$ ) with chlorine ( $Cl_2$ ).

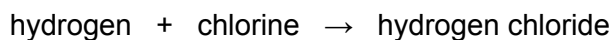
- (a) The diagrams represent molecules of hydrogen and chlorine.



Draw a similar diagram to represent a molecule of hydrogen chloride (HCl).  
You need show only the outer energy level (shell) electrons.

(1)

(b) The word equation for the reaction of hydrogen with chlorine is shown below.



Write a balanced symbol equation for this reaction.

.....

(2)

(c) Hydrogen chloride gas reacts with magnesium to form the ionic compound called magnesium chloride. Use the table of ions on the Data Sheet to help you to write the formula of magnesium chloride.

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(1)

(d) Why does magnesium chloride have a much higher melting point than hydrogen chloride?

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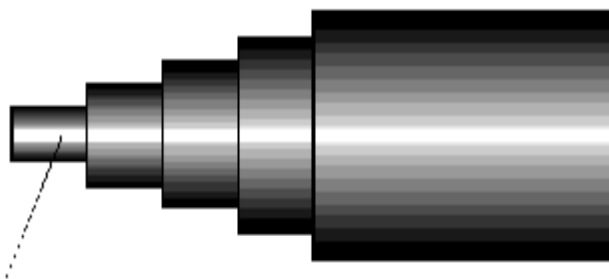
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(2)

(Total 6 marks)

6

The drawing shows a high quality wire used to make electrical connections on a hi-fi system.



Multi-strand "OFC" copper  
to maintain high signal purity



- (a) Copper is used because it is a very good conductor of electricity. Copper is a typical metal.
- (i) Describe the structure and bonding in a metal. You may wish to draw a diagram to help you to answer this question.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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**(3)**

- (ii) Explain, by reference to your answer to part (a)(i), why copper conducts electricity.

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**(1)**

- (iii) Explain, by reference to your answer to part (a)(i), why copper can be drawn into wires.

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**(1)**

- (b) The copper used to make this wire is "OFC" copper. This stands for 'oxygen free copper'.
- (i) It is thought that when molten copper is cooled and solidified it can take in some oxygen from the air. This may slightly decrease the conductivity of the copper.

Suggest why the conductivity might be decreased.

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(2)

- (ii) To make it oxygen free, the copper is heated in an atmosphere of hydrogen.

Explain how this will remove the oxygen.

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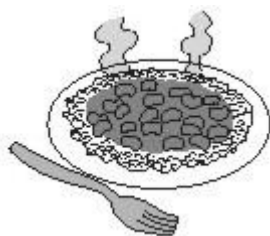
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(1)

(Total 8 marks)

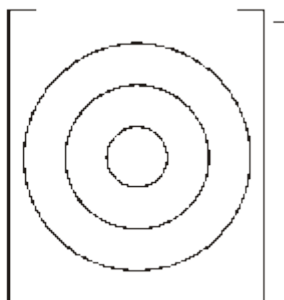
7

- (a) A tin of red kidney beans contains calcium chloride as a firming agent.



Calcium chloride is an ionic compound which contains calcium ions ( $\text{Ca}^{2+}$ ) and chloride ions ( $\text{Cl}^-$ ).

- (i) The diagram on the left represents the electronic structure of a chlorine atom.



Complete a similar diagram on the right to represent a chloride ion.

(2)

- (ii) Explain how a calcium **atom** changes into a calcium **ion** which has a 2+ charge.

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(2)

- (b) Cola drinks contain phosphoric acid,  $\text{H}_3\text{PO}_4$ . The two equations show how phosphoric acid can be made from phosphorus.

Balance these two equations.



(1)



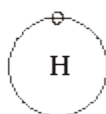
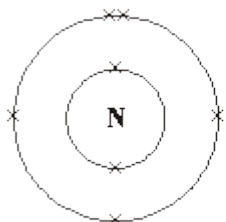
(1)

(Total 6 marks)

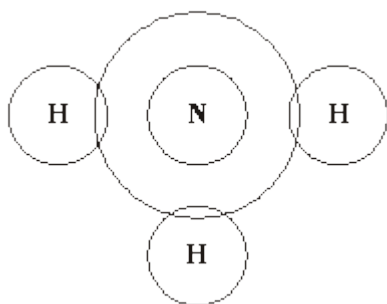
8

Ammonia ( $\text{NH}_3$ ) is an important chemical which is used to make fertilisers. Ammonia is made from nitrogen and hydrogen,

- (a) The diagrams represent the electron arrangements in atoms of nitrogen and hydrogen.



Complete the diagram showing the arrangement of electrons in a molecule of ammonia.



(1)

(b) Name the type of bonding which holds the nitrogen and hydrogen atoms together in an ammonia molecule.

.....

(1)

(Total 2 marks)

9

Millions of years ago the Earth formed as a giant ball of molten rock. The outer surface cooled forming a thin, solid outer crust. Volcanic activity on the surface produced an atmosphere containing the compounds carbon dioxide, ammonia, methane and water vapour.

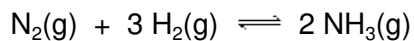
Describe the bonding in any **one** of these compounds. You must include electronic structures in your explanation.

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(Total 4 marks)

**10**

Transition metals are useful as catalysts. Iron is used as a catalyst in the manufacture of ammonia.



(i) What is meant by  $\rightleftharpoons$  in the chemical equation?

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**(1)**

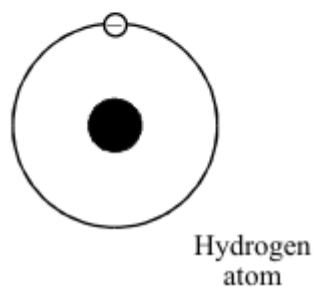
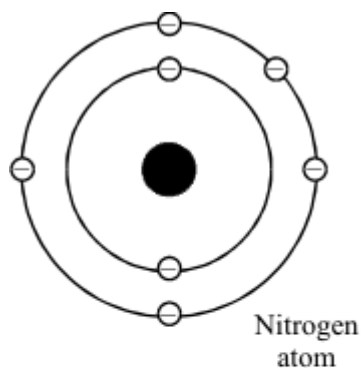
(ii) What would be the effect on the yield of ammonia if the pressure was increased?

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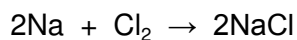
**(1)**

(iii) Draw a diagram to show the arrangement of the electrons in a molecule of ammonia. The electron arrangement of each atom is shown.

**(1)****(Total 3 marks)**

11

Sodium reacts with chlorine to form the compound sodium chloride.



Describe, in terms of electron arrangement, the type of bonding in:

(i) a molecule of chlorine;

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(3)

(ii) the compound sodium chloride.

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(4)

(Total 7 marks)

12

Early atmospheres on Earth contained ammonia (NH<sub>3</sub>).

(a) (i) Complete the sentence.

Our atmosphere today is made up of about ..... % nitrogen.

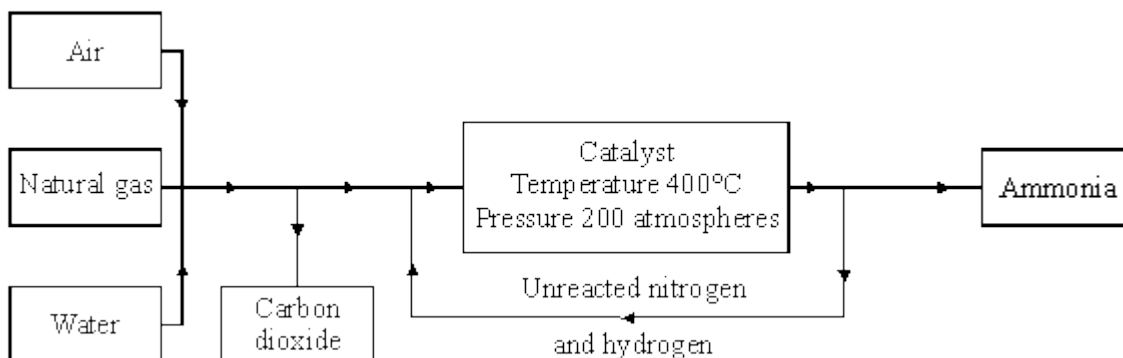
(1)

(ii) Today we convert nitrogen back to ammonia mainly for the production of fertilisers. What do plants convert the nitrogen in these fertilisers into?

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(1)

(b) The conversion of nitrogen to ammonia is shown.



(i) When making ammonia, what is **one** source of hydrogen?

.....

(1)

(ii) Apart from ammonia, name **one** other product formed during this conversion.

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(1)

(c) The main reaction is the formation of ammonia from nitrogen and hydrogen.

(i) Complete and balance the equation for this reaction.



(2)

(ii) Name the metal catalyst used in this reaction.

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(1)

(iii) This reaction does not work successfully at room temperature (20 °C) and needs a much higher temperature of 400 °C. Explain why.

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(2)

- (d) Draw a diagram to show the arrangement of the electrons in a molecule of ammonia. The electron arrangement of each atom is hydrogen 1 and nitrogen 2.5.

(2)

**(Total 11 marks)****13**

Many everyday substances can be classified as acids, bases or salts. For example, car batteries contain sulphuric acid, oven cleaners contain sodium hydroxide and table salt contains sodium chloride.

- (a) A solution of each of these substances was tested with universal indicator.

<b>Solution</b>	<b>Colour of universal indicator</b>
Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> )	red
Sodium hydroxide (NaOH)	purple
Sodium chloride (NaCl)	green

- (i) Explain how these universal indicator colours and the corresponding pH values could be used to identify each of these solutions.

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.....

**(3)**

- (ii) Name and give the formula of the ion which causes the solution to be acidic.

Name of ion .....

Formula of ion .....

**(2)**



(b) Sodium chloride can be made by reacting sodium hydroxide with hydrochloric acid in the presence of an indicator.

(i) What is the name of this type of reaction?

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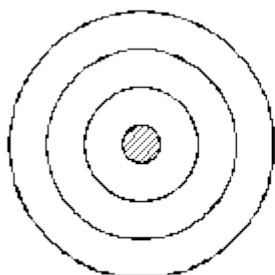
(1)

(ii) Write a balanced chemical equation for this reaction.

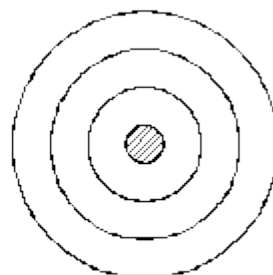
.....(aq) + .....(aq) → .....(aq) + .....(l)

(2)

(c) The atomic number for sodium is 11 and for chlorine is 17.



Sodium atom



Chlorine atom

(i) Complete the diagrams to show the electron arrangements for a sodium atom and a chlorine atom.

(2)

(ii) These atoms form different particles by one electron transferring from the sodium atom to the chlorine atom. What is the name given to the particles formed?

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(1)

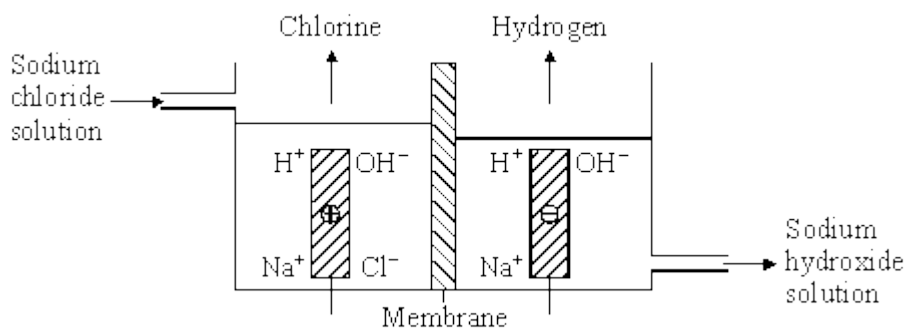
(iii) Why do these sodium and chloride particles bond?

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(1)

(d) Sodium chloride solution is electrolysed to form three products, hydrogen, chlorine and sodium hydroxide.



Describe how each of these products are formed.

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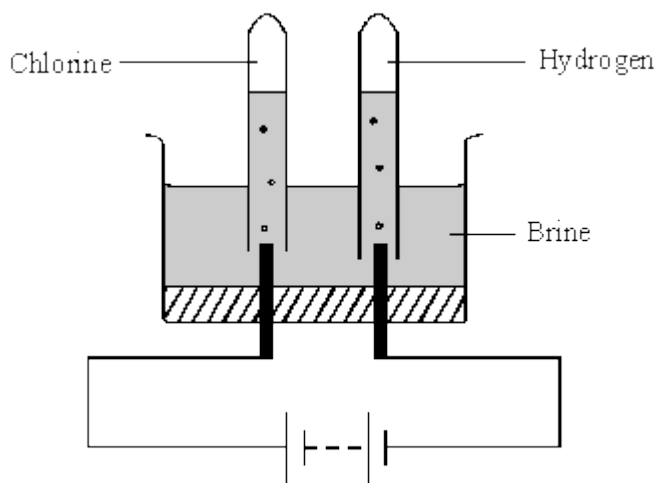
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(3)  
(Total 15 marks)

14

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
Cl	2.8.7

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

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(2)

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

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(3)

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

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(3)

(Total 8 marks)

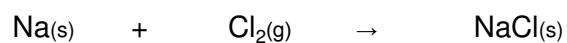
15

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

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

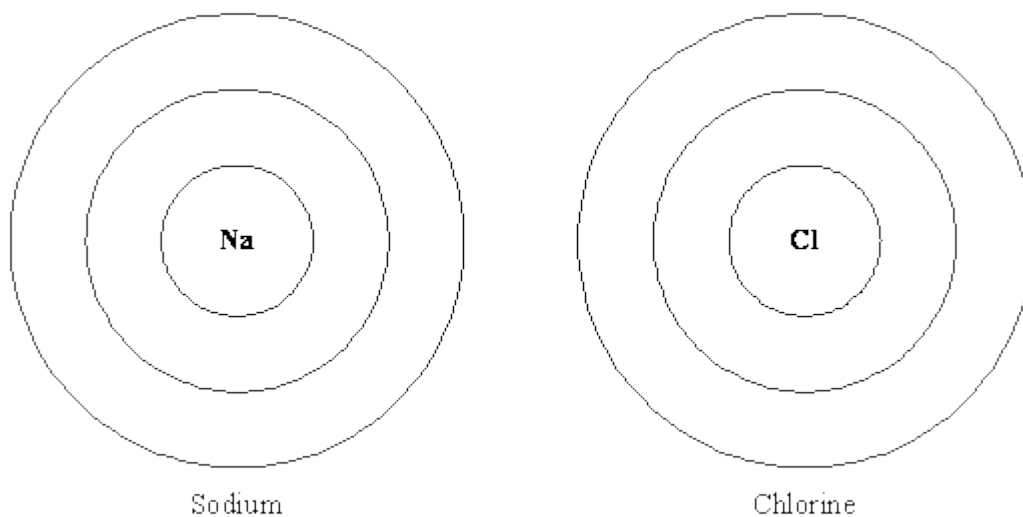


- (a) Balance the symbol equation for the reaction of sodium with chlorine.



(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 ( $\text{Na}^+$ ) and the chlorine atoms are changed into chloride ions ( $\text{Cl}^-$ ).

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)

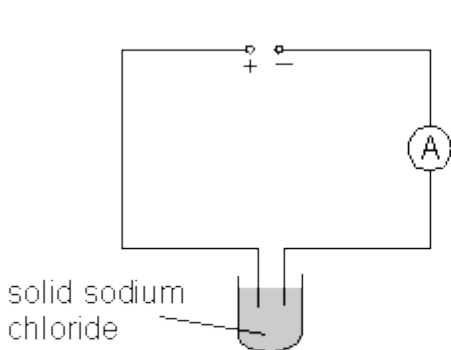
By reference to the electronic structures of potassium and sodium explain:

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

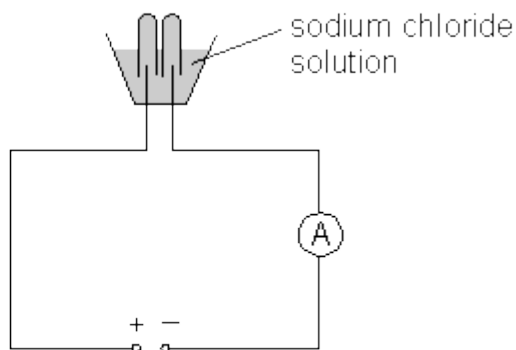
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(1)

- (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?

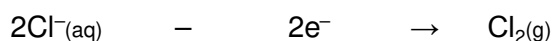
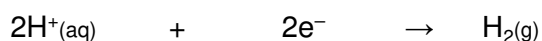
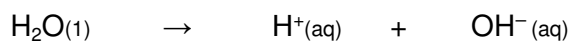
..... A

- (ii) Explain your answer.

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 .....

(3)

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



- (i) Which substance provides hydrogen ions?

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(1)

- (ii) Name the product formed at:

(A) the positive electrode;

.....

(B) the negative electrode.

.....

(1)

(Total 15 marks)

16

Fluorine is a very useful element. It is placed in group 7 of the Periodic Table.

Use your knowledge of the elements in group 7 to help you answer these questions. You may find that information in the Data Sheet may help you with this question.

- (a) Name another element in group 7 of the Periodic Table.

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(1)

- (b) Cylinders filled with fluorine molecules are commercially available. What would you expect the formula of a fluorine molecule to be?

.....

(1)

- (c) Fluoride ions are added to drinking water to help prevent tooth decay. What is the charge on fluoride ions in the water?

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(1)

- (d) Fluorine reacts with the non-metal sulphur to make sulphur hexafluoride ( $\text{SF}_6$ ).

- (i) What type of bonding would you expect in sulphur hexafluoride?

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(1)

- (ii) Explain the reason for your answer to part (i).

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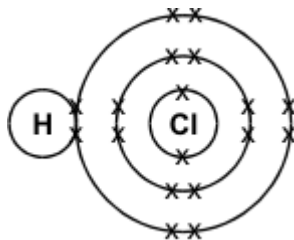
(1)

(Total 5 marks)

17

The hydrogen halides (hydrogen fluoride, hydrogen chloride, hydrogen bromide and hydrogen iodide) are important chemicals.

The diagram below represents a molecule of hydrogen chloride.



- (i) What type of particles are represented by the crosses (X)?

.....

(1)

- (ii) What type of chemical bond holds the atoms in this molecule together?

.....

(1)

- (iii) Would you expect hydrogen chloride to be a gas, a liquid or a solid, at room temperature and pressure? Explain your answer.

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(3)  
(Total 5 marks)

18

The extract below was taken from a leaflet on the uses of platinum. One of the uses described was in making electrodes for spark plugs in car engines. The spark plug produces the spark which ignites the fuel in the engine.

<b>Spark Plugs</b>				
The electrodes in a spark plug have to conduct electricity very well. Since they project into the combustion chamber of the engine, they must also be able to withstand extremely high temperatures in a very corrosive atmosphere.				
Nickel-based plugs have been produced for many years. They only last a fairly short time. As the electrodes wear, combustion becomes less efficient and the petrol is not burnt completely.				
Platinum and other precious metals can now be used in spark plugs. These last much longer and are more efficient. This can help to reduce air pollution.				

The table below gives some information about platinum and nickel.

	MELTING POINT (° C)	BOILING POINT (° C)	POSITION IN REACTIVITY SERIES	COST (£/kg)
nickel	1455	2920	Higher than gold	2.5
platinum	1769	4107	below gold	6110

- (a) Compare nickel and platinum for use in making the electrodes in spark plugs.

A good answer should give advantages and disadvantages of each metal linking these to the properties of the metals. Marks will be given for the way in which you organise your answer.

***You will need a sheet of lined paper.***

(8)



(b) (i) Describe the structure and bonding in metals.

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(3)

(ii) Explain why metals such as nickel and platinum are good conductors of electricity.

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(2)

(Total 13 marks)

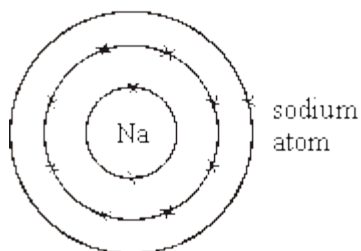
19

(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.



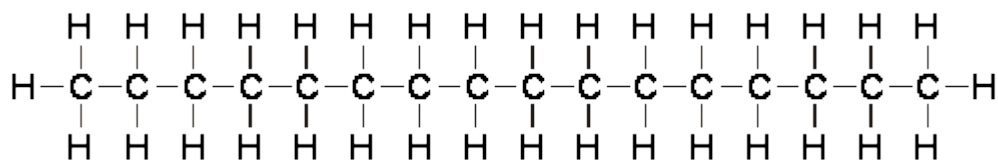
(i) Draw a similar diagram for a fluorine atom.

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

(4)  
(Total 5 marks)

20

Diesel oil is obtained from crude oil. It can be used as a fuel for car engines. The diagram below represents a compound found in diesel oil.



(a) What is the formula of this compound?

.....

(1)

(b) Each of the lines on the diagram above represents a covalent bond.

What is a covalent bond?

.....

.....

(2)  
(Total 3 marks)

21

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.



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

.....

(1)

- (b) Sando-K contains the ion,  $\text{CO}_3^{2-}$ . 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)

**22**

Calcium and magnesium are elements. They are found in the Earth's crust as compounds, often carbonates and sulphates. Magnesium is also found as its chloride.

- (a) Calcium and magnesium are in the same Group in the Periodic Table. State which Group this is.

.....

(1)

- (b) Use the Data Sheet to help you to answer this question.

- (i) Write the chemical formula of magnesium chloride.

.....

(1)

- (ii) Name the type of bonding in magnesium chloride.

.....

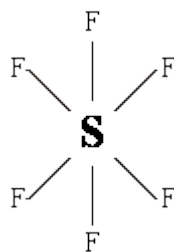
(1)

(Total 3 marks)

**23**

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: .....

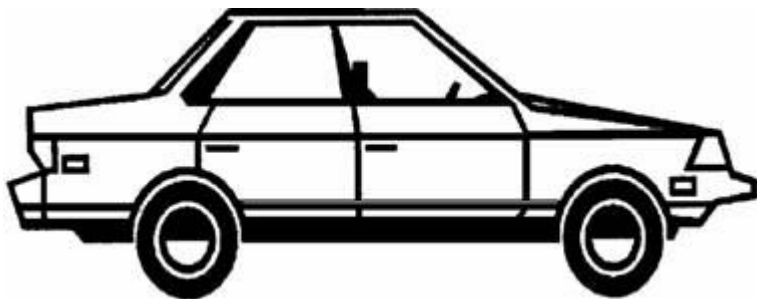
.....

(3)

(Total 6 marks)

24

Iron is used (as steel) to make the body panels for cars.



The iron panels have to be bendable so that they can be pressed into the shape required, but must also be strong. The panels must also be able to conduct electricity because they form part of the electrical circuits of the car.

- (a) Iron is a typical metal. Describe the structure and bonding in a metal such as iron. You may use a diagram if you wish.

.....  
.....  
.....  
.....  
.....  
.....  
.....

(4)

- (b) Explain how the structure and bonding of iron:

- (i) allows the body panels to conduct electricity;

.....

(2)

- (ii) allows the body panels to be bent into shape;

.....

(1)

- (iii) gives the body panels strength.

.....

(1)

(Total 8 marks)

25

X is an element with the following properties:

- melts at  $-220^{\circ}\text{C}$  and boils at  $-188^{\circ}\text{C}$ ;
- does not conduct electricity at room temperature;
- forms molecular compounds with non-metals;
- forms ionic salts with metals in which its ion has a 1–charge.

- (a) Would you expect X to be a solid, a liquid or a gas at  $20^{\circ}\text{C}$ ?

.....

(1)

(b) Predict the formula of the product formed when X reacts with aluminium.

(The aluminium ion is  $\text{Al}^{3+}$  and the X ion is  $\text{X}^-$ .)

Select your answer from the list below.



Predicted formula .....

(1)

(c) To which Group of the Periodic Table does the element X belong?

.....

(1)

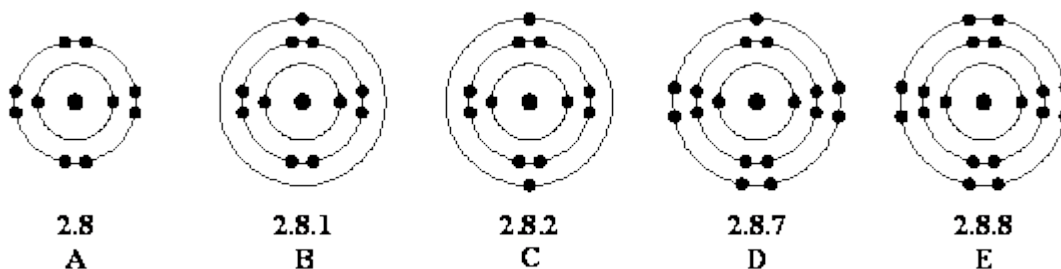
(Total 3 marks)

**26**

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 .....

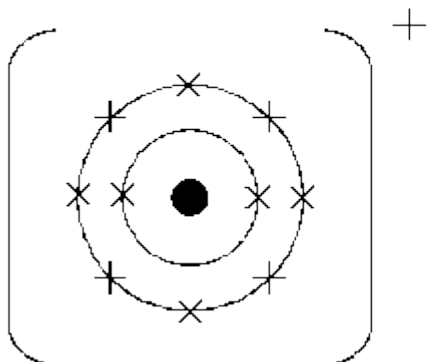
(ii) A sodium ion,  $\text{Na}^+$  .....

(Total 2 marks)

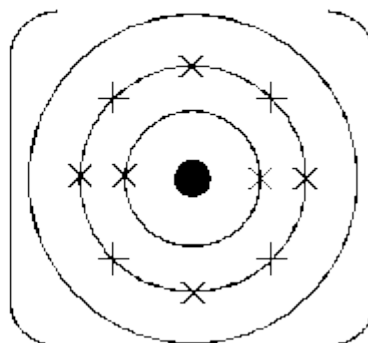
**27**

Sodium chloride is an ionic compound.

This is a diagram of a sodium ion.

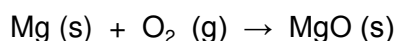


Complete this diagram of a chloride ion.

**(Total 2 marks)****28**

(a) Magnesium burns in oxygen, forming magnesium oxide.

This equation represents the reaction.



(i) Balance the equation.

**(1)**

(ii) Give the meaning of the state symbols (s) and (g).

(s) .....

(g) .....

**(2)**

(b) Use the Formulae of Some Common Ions table on the Data Sheet to help you to answer this question.

Magnesium also reacts with chlorine to form magnesium chloride.

Give the formula of magnesium chloride .....

**(1)****(Total 4 marks)****29**

(a) A piece of lithium is placed on the surface of some water in a beaker. Hydrogen is given off. Lithium hydroxide is also formed.

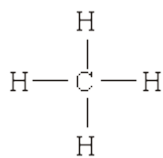
Write a word equation for this reaction.

.....

**(2)**



- (b) The diagram shows the structure of a molecule of methane.



Write down everything that this diagram tells you about a methane molecule.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

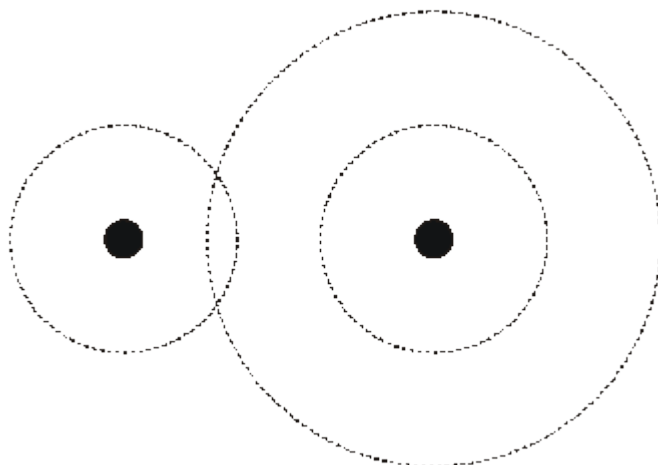
.....

.....

(4)  
(Total 6 marks)

30

- (i) Complete the drawing to show the electron structure of a hydrogen fluoride molecule. Draw electrons as dots or crosses.



(1)

- (ii) Explain why hydrogen fluoride is a gas at room temperature.

.....

.....

.....

.....

(2)  
(Total 3 marks)

31

- (a) In industry ammonia is produced from nitrogen and hydrogen. The equation for the reaction is:



- (i) What does the symbol (g) represent?

.....

(1)

- (ii) What does the symbol  $\rightleftharpoons$  represent?

.....

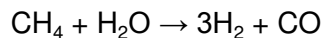
(1)

- (iii) Nitrogen is used for the industrial production of ammonia. From what raw material does this nitrogen come?

.....

(1)

- (iv) Hydrogen is used for the industrial production of ammonia. It is obtained from the reaction between methane and steam. The equation for this reaction is:



Explain how you can tell that this equation is balanced.

.....

.....

.....

.....

(2)

(b) Ammonia is used to make ammonium salts which can be used as fertilisers.

(i) Complete the names in the following sentence.

One example is ammonium ..... which is made by reacting  
ammonia with ..... acid.

(2)

(ii) All ammonium salts are soluble in water. Why is this a useful property of a fertiliser?

.....  
.....

(1)

(c) Ammonia is a covalent, chemical compound.

(i) Complete the following sentence to describe a chemical compound.

In a chemical compound, two or more .....  
.....  
.....

(1)

(ii) What is a covalent bond?

.....  
.....

(1)

**(Total 10 marks)**

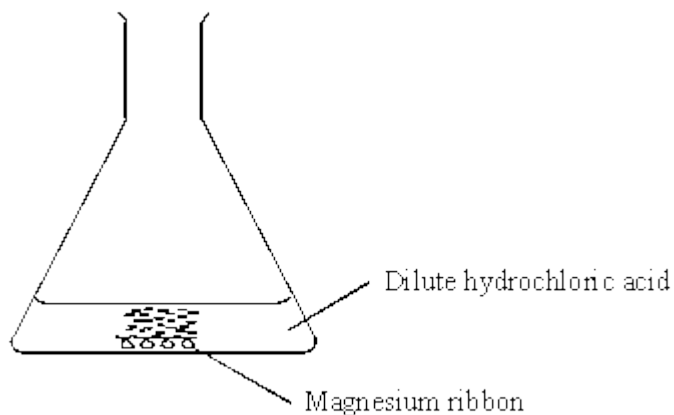
**32**

In this question you will need to use the following information:

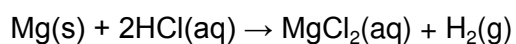
Relative atomic masses: H 1; O 16; Mg 24.

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and atmospheric pressure.

The diagram shows a chemical reaction taking place in a conical flask.



The balanced equation for this reaction is:



(a) Write a balanced ionic equation for this reaction.

.....

(2)

(b) Calculate the mass of magnesium required to produce 0.50 g of hydrogen. Show clearly how you work out your final answer and give the unit.

.....

.....

Mass = .....

(2)

(c) (i) Draw a diagram to show how the electrons are arranged in a hydrogen molecule.

(1)

(ii) What is the name of the type of chemical bond between the hydrogen atoms in a hydrogen molecule?

.....

(1)

- (d) The chemical formula for hydrogen peroxide is  $\text{H}_2\text{O}_2$ .

Calculate, to the nearest whole number, the percentage, by mass, of hydrogen in hydrogen peroxide. Show clearly how you work out your answer.

.....

.....

Percentage = ..... %

(2)  
(Total 8 marks)

33

- (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:		
		1 <sup>st</sup> shell	2 <sup>nd</sup> shell	3 <sup>rd</sup> 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)

34

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)

35

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  $\text{Na}_2\text{O}$ .

(3)

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

.....  
 .....

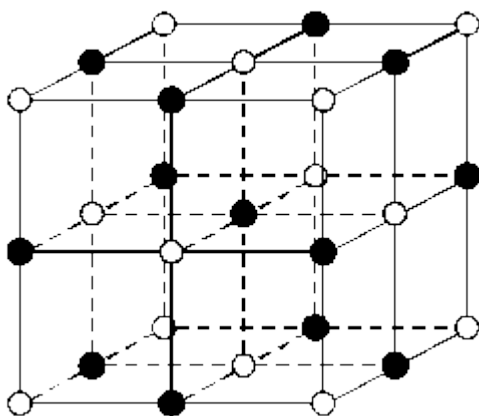
(1)

(Total 6 marks)



36

- (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)

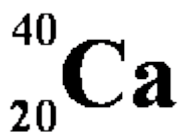
- (iii) Complete the sentence.

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:



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

.....

(1)

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

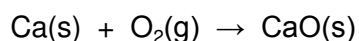
.....

.....

(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.



(1)

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

.....

.....

.....

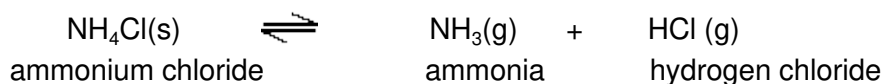
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(2)

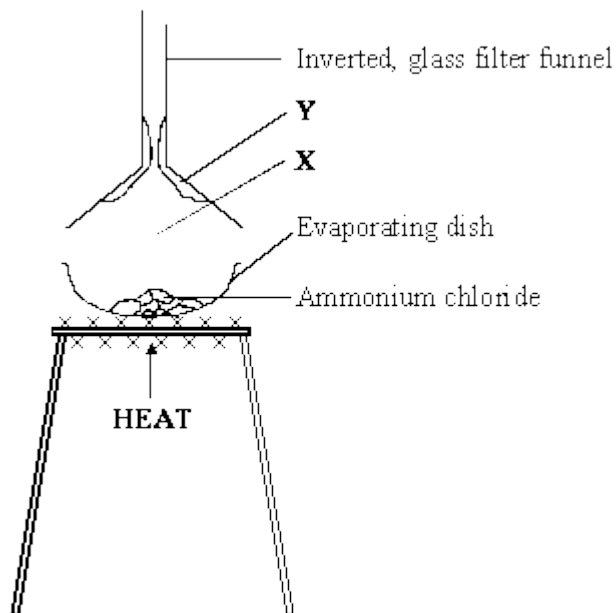
**(Total 10 marks)**

37

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



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  $\text{NH}_3$ . 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?

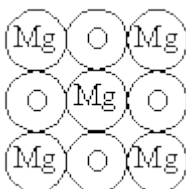
..... and .....

(1)

(Total 10 marks)

38

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



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

(1)

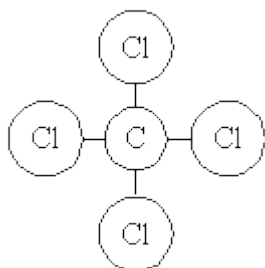
(b) Explain how the magnesium ions get this charge.

.....  
.....  
.....

(2)  
(Total 3 marks)

39

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)

**40**

(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.

.....

.....

.....

.....

.....

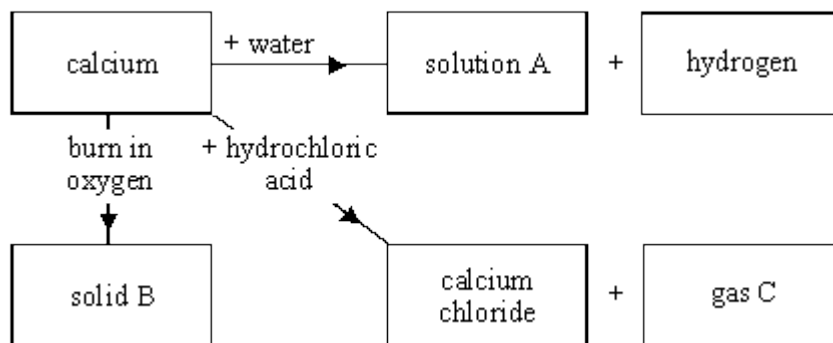
.....

.....

(4)  
(Total 9 marks)

41

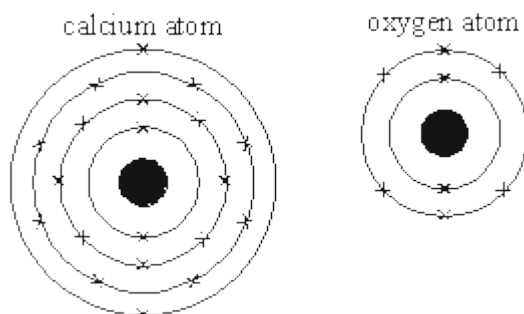
- (a) The chart shows the reactions of the metal calcium with water, oxygen and dilute hydrochloric acid.



- 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)

42

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	$\text{H}_2\text{SO}_4$	$[\text{H}]^+[\text{SO}_4]^{2-}[\text{H}]^+$
ethene	$\text{C}_2\text{H}_4$	

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)

43

- (a) Balance these chemical equations.



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

.....

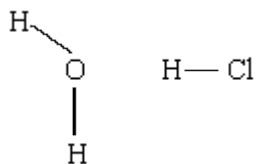
.....

.....

.....

(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).

.....

.....

.....

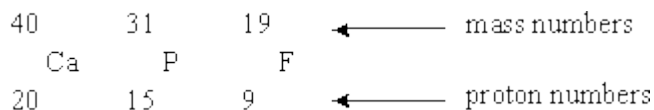
.....

(3)

(Total 7 marks)

**44**

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,  $\text{CaF}_2$ .

The fluoride ion is represented by  $\text{F}^-$ .

(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.

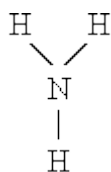
.....  
.....  
.....

(2)

**(Total 14 marks)**

45

The diagram shows one molecule of the compound ammonia.



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

.....

.....

.....

.....

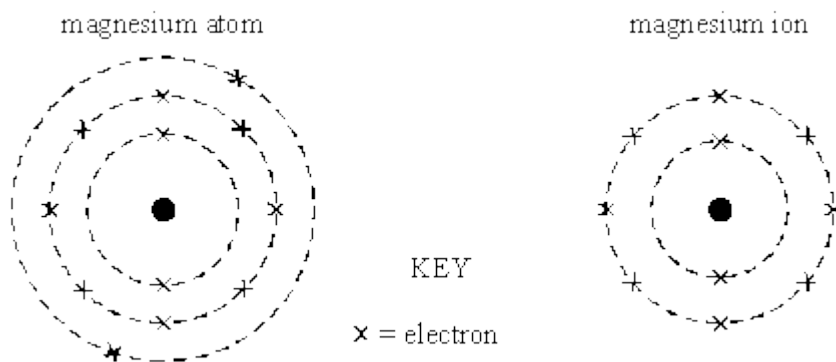
.....

.....

(Total 4 marks)

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  $\text{CaBr}_2$ .

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

.....

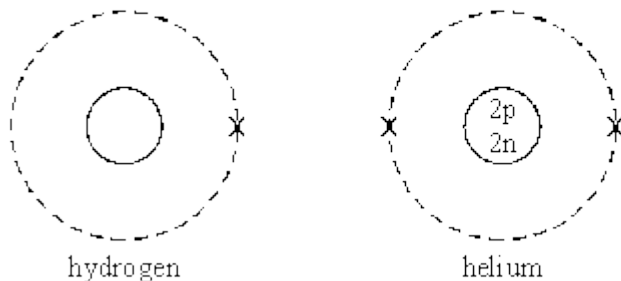
.....

(2)  
(Total 4 marks)

47

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

x = an electron  
p = a proton  
n = a neutron



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)

.....  
.....  
.....

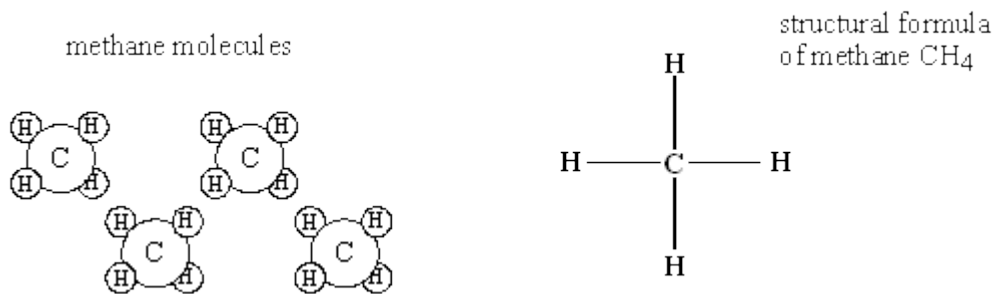
(2)

(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)