AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.1 CHEMICAL BONDS: IONIC, COVALENT AND METALLIC (PACK 3)

SCORE	PERCENTAGE
/221	%

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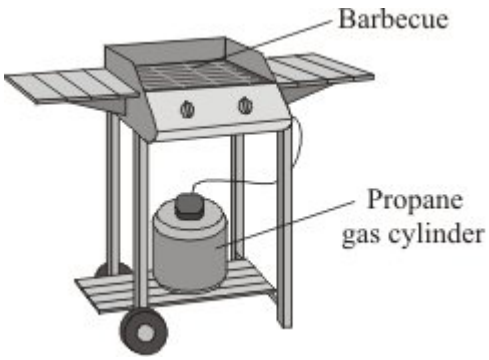
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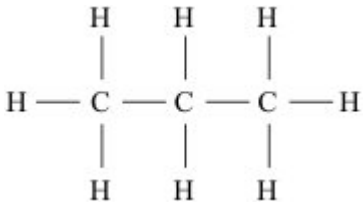
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Q1.

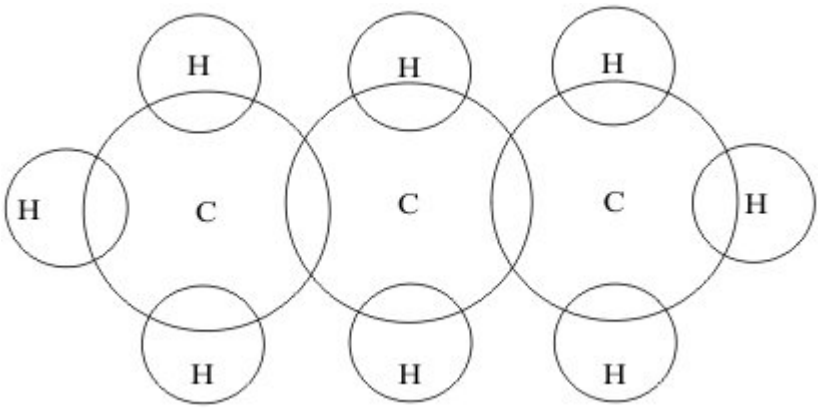
This barbecue burns propane gas.



The structure of propane is shown below.



(a) Complete the diagram to show how the outer energy level (shell) electrons of hydrogen and carbon are arranged in a molecule of propane.

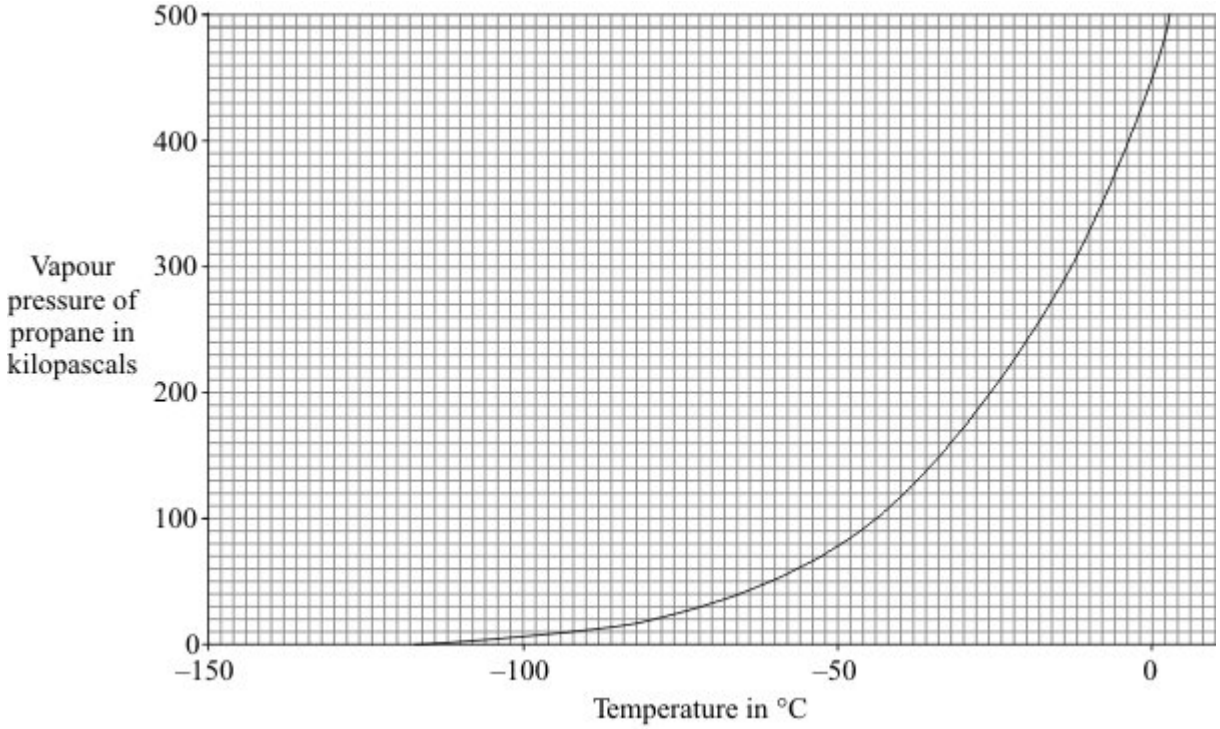


(1)

(b) The graph shows how the vapour pressure of propane changes with temperature.

The vapour pressure of a liquid is the pressure of the vapour above the liquid.

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(i) Describe, as fully as you can, how the vapour pressure of propane changes with temperature.

_____

_____

_____

_____

_____

(2)

(ii) The boiling point of a liquid is the temperature at which its vapour pressure is equal to the air pressure above the liquid.

Use the graph to find the boiling point of propane when the air pressure is 100 kilopascals.

Boiling point _____ °C

(1)

(c) Explain, in terms of molecules, why propane has a low boiling point.

_____

_____

_____

_____

_____

(2)

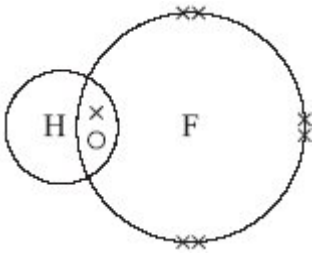
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(Total 6 marks)

Q2.

This question is about fluorine and some of its compounds.

(a) The diagram represents a molecule of hydrogen fluoride.



Draw a ring around the type of bonding that holds the hydrogen and fluorine atoms together in this molecule.

covalent **ionic** **metallic**

(1)

(b) Fluorine is made in industry by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.

(i) Use **one** word from the box to complete the sentence.

gas	**liquid**	**solid**

To allow electrolysis to take place the mixture of potassium fluoride and hydrogen fluoride must be _____ .

(1)

(ii) The mixture of potassium fluoride and hydrogen fluoride contains fluoride ions (F^-), hydrogen ions (H^+) and potassium ions (K^+).

Use **one** word from the box to complete the sentence.

fluorine	**hydrogen**	**potassium**

During electrolysis the element formed at the **positive** electrode is _____ .

(1)

(c) Fluoride ions are sometimes added to drinking water. It is thought that these ions help to reduce tooth decay.

(i) Tick (✓) **one** question that **cannot** be answered by scientific investigation alone.

Question	**Tick (✓)**

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Do fluoride ions in drinking water reduce tooth decay?	
Are fluoride ions in drinking water harmful to health?	
Should fluoride ions be added to drinking water?	

(1)

(ii) Explain why you have chosen this question.

_____

_____

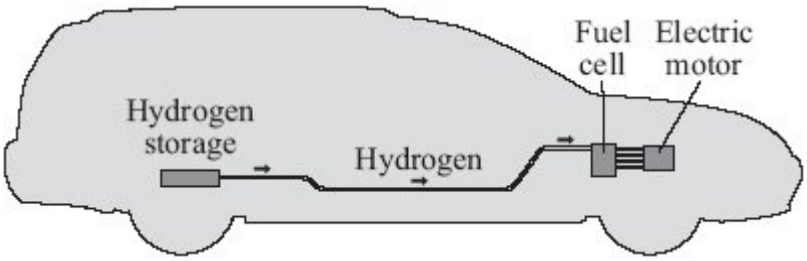
(1)

(Total 5 marks)

Q3.

Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. It can be made by the electrolysis of potassium hydroxide solution.

Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. A chemical reaction takes place between the hydrogen and the lithium nitride. The hydrogen is held in the resulting compounds by chemical bonds.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. These particles absorb hydrogen in the same way as normal sized lithium nitride particles. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

It is hoped that 'nanosized' particles of lithium nitride may provide a safe method of storing hydrogen in the future.

(a) Hydrogen is produced at the negative electrode during the electrolysis of potassium hydroxide solution.

(i) Why are hydrogen ions attracted to the negative electrode?

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_____

_____

_____

(1)

(ii) Potassium ions are also attracted to the negative electrode.

Explain why hydrogen gas is formed but not potassium.

_____

_____

_____

(1)

(b) Lithium nitride is made by reacting lithium with nitrogen.

Balance the equation for this reaction.

$$_____\ Li + N_2 \rightarrow _____\ Li_3N$$

(1)

(c) (i) The equation for the reaction of lithium nitride with hydrogen is:

$$Li_3N + 2H_2 \rightleftharpoons LiNH_2 + 2LiH$$

What feature of this reaction allows the hydrogen to be released?

_____

_____

(1)

(ii) Hydrogen stored in a fuel tank filled with lithium nitride would be safer in an accident than a cylinder full of hydrogen.

Suggest and explain why.

_____

_____

_____

_____

_____

(2)

(d) Lithium nitride is an ionic compound which contains lithium ions (Li^+) and nitride ions (N^{3-}).

(i) The formation of a lithium ion from a lithium atom is an oxidation reaction.

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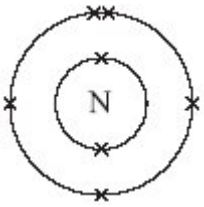
Explain why.

_____

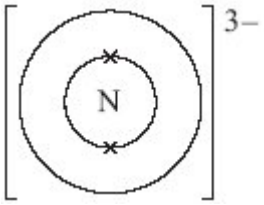
_____

(1)

(ii) The diagram shows the electronic structure of a nitrogen atom.



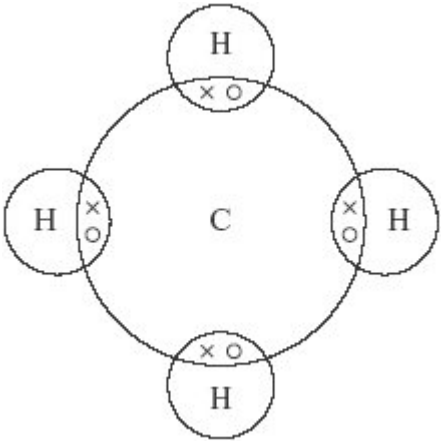
Complete the diagram below to show the electronic structure of a nitride ion (N^{3-}).



(1)
(Total 8 marks)

Q4.

The diagram represents a particle of methane.



(a) What is the formula of methane? _____

(1)

(b) Choose a word from the box to answer the question.

atom	**ion**	**molecule**

Which of the words best describes the methane particle shown in the diagram?

_____

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(1)

(c) Choose a word from the box to answer the question.

covalent	ionic	metallic

What is the type of bonding shown in the diagram?

_____

(1)
(Total 3 marks)

Q5.

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*.

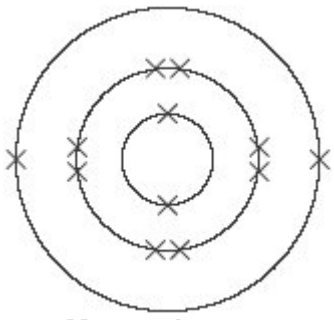
Complete the following sentence using the correct words from the box.

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?

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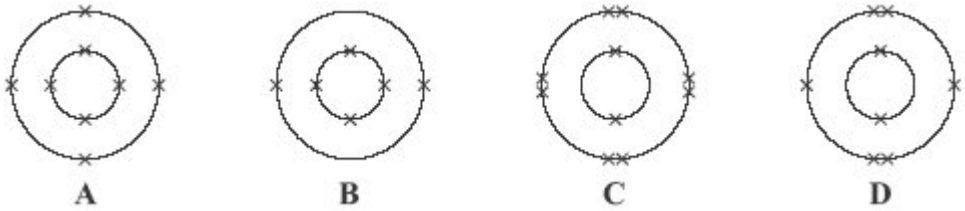
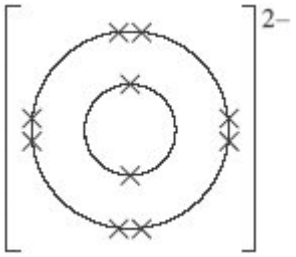


Diagram _____

(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?

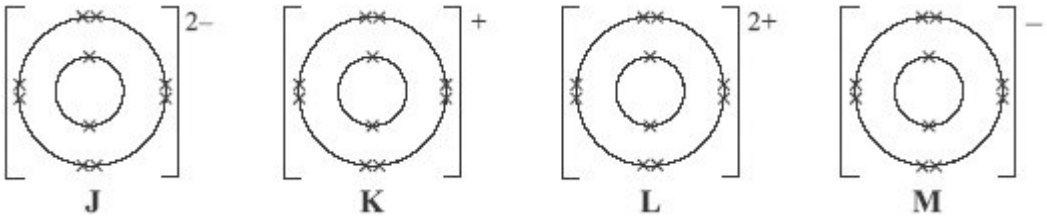


Diagram _____

(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)

Q6.

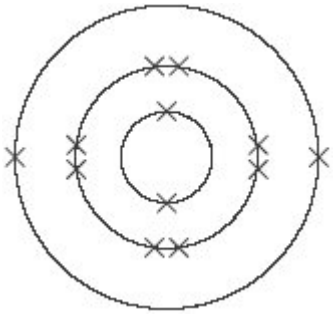
(a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O_2) to form magnesium oxide (MgO).

_____

(1)

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

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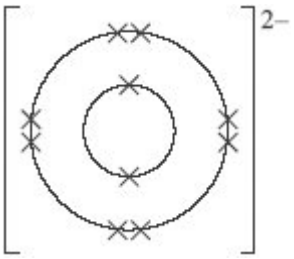
Magnesium atom

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.

_____

_____

_____

_____

(2)

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(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.

hydrochloric acid + magnesium oxide → _____ + water.

(1)

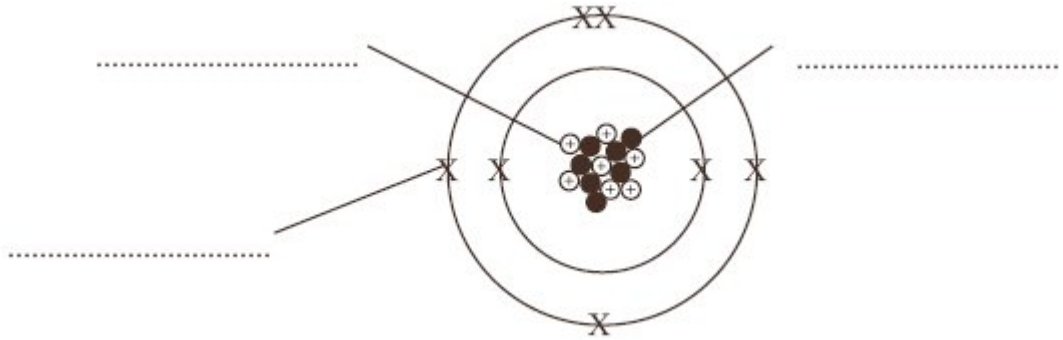
(Total 6 marks)

Q7.

(a) The diagram represents an atom of nitrogen.

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

electron	neutron	nucleus	proton



(2)

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

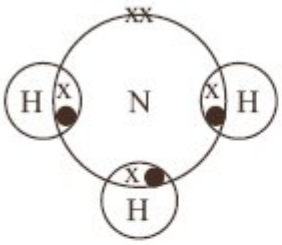
5 **7** **14** **21**

(1)

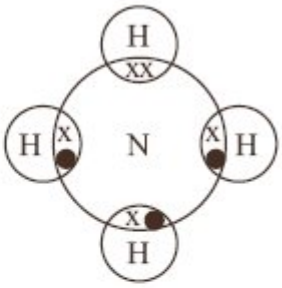
(b) Nitrogen can react with hydrogen to make ammonia, NH_3 .

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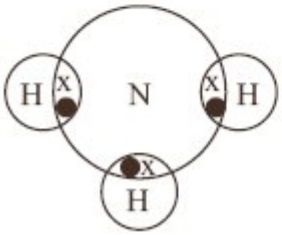
A



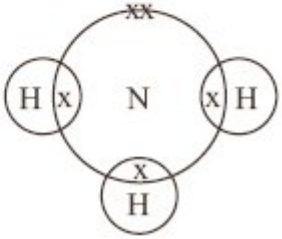
B



C



D



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

(1)

(Total 4 marks)

Q8.

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



Some toothpastes contain tin(II) fluoride.

This compound has the formula SnF_2 .

(a) Calculate the relative formula mass (M_r) of 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 SnF_2.

_____

_____

_____

_____

Percentage by mass of fluorine = _____ %

(2)

(c) A tube of toothpaste contains 1.2 g of SnF_2.

Calculate the mass of fluorine in this tube of toothpaste.

_____

_____

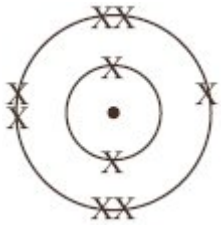
_____

_____

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^-.

_____

_____

_____

_____

(2)

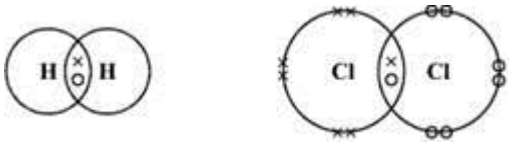
(Total 7 marks)

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Q9.

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.

hydrogen + chlorine → hydrogen chloride

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.

_____

(1)

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

_____

_____

_____

_____

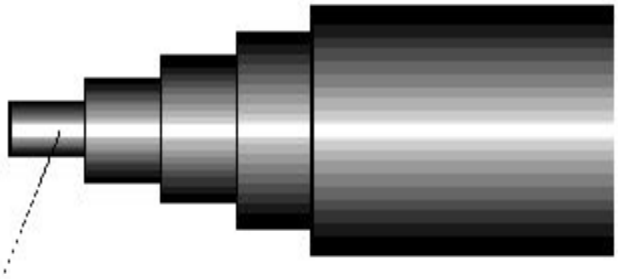
(2)

(Total 6 marks)

Q10.

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



Multi-strand "OFC" copper
to maitain 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.

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

(1)

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

_____

_____

(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.

_____

_____

_____

_____

(2)

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

Explain how this will remove the oxygen.

_____

_____

_____

_____

(1)

(Total 8 marks)

Q11.

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

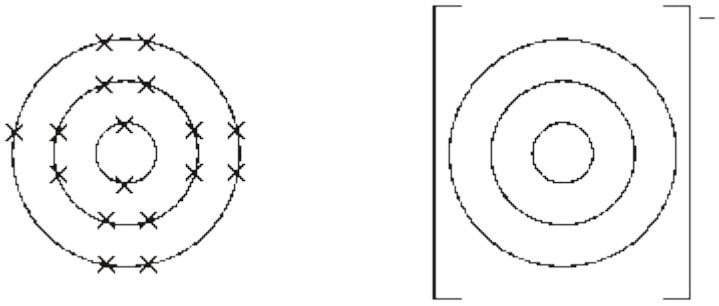


Calcium chloride is an ionic compound which contains calcium ions (Ca^{2+}) and chloride ions (Cl^{-}).

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

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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.

_____

_____

_____

_____

(2)

(b) Cola drinks contain phosphoric acid, H_3PO_4. The two equations show how phosphoric acid can be made from phosphorus.

Balance these two equations.

(i) P_4 + ____ $O_2 \rightarrow P_4O_{10}$

(1)

(ii) P_4O_{10} + _____ $H_2O \rightarrow 4H_3PO_4$

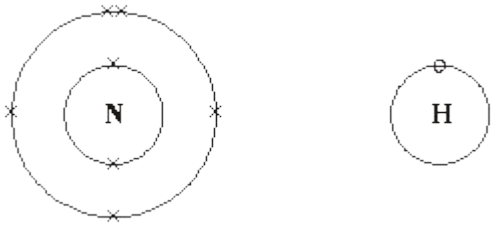
(1)

(Total 6 marks)

Q12.

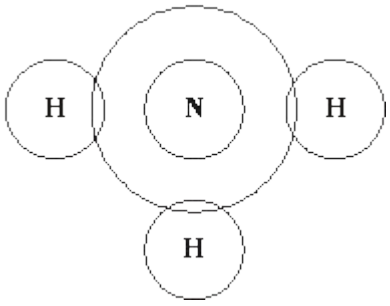
Ammonia (NH_3) is an important chemical which is used to make fertilisers. Ammonia is made from nitrogen and hydrogen,

(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.

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(1)

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

_____

(1)

(Total 2 marks)

Q13.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q14.

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

$N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$

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

_____

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_____

(1)

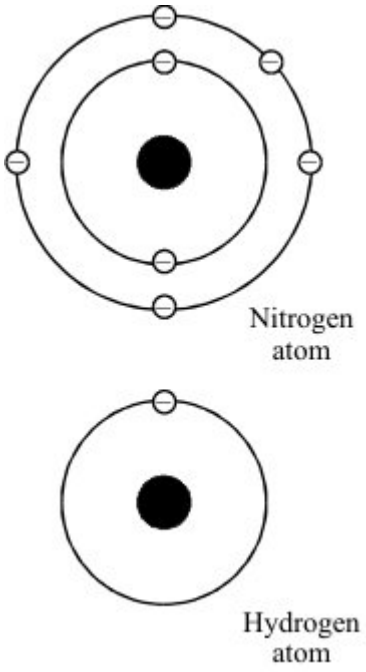
(ii) What would be the effect on the yield of ammonia if the pressure was increased?

_____

_____

(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)

Q15.

Sodium reacts with chlorine to form the compound sodium chloride.

$2Na + Cl_2 \rightarrow 2NaCl$

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.

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Q16.

Early atmospheres on Earth contained ammonia (NH_3).

(a) (i) Complete the sentence.

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

(1)

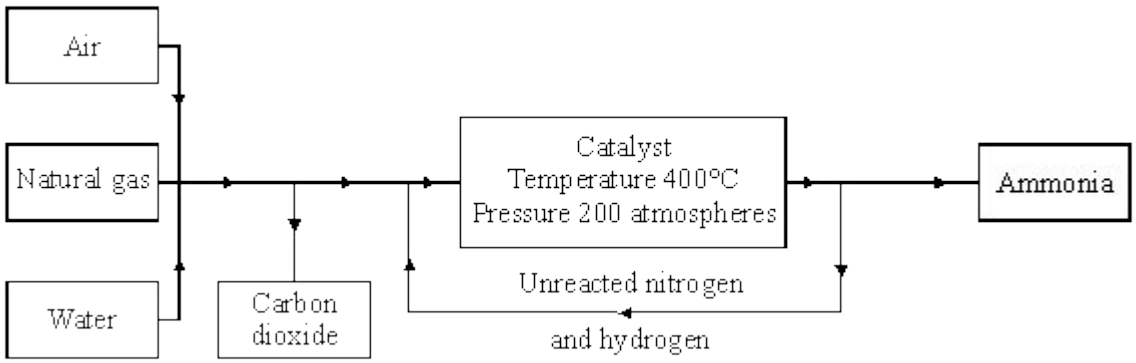
(ii) Today we convert nitrogen back to ammonia mainly for the production of fertilisers. What do plants convert the nitrogen in these fertilisers into?

_____

_____

(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.

_____(g) + _____(g) → _____NH_3(g)

(2)

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

_____

(1)

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

_____

_____

_____

(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)

Q17.

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.

Solution	Colour of universal indicator
Sulphuric acid (H_2SO_4)	red
Sodium hydroxide (NaOH)	purple
Sodium chloride (NaCl)	green

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

_____

_____

_____

_____

_____

(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?

_____

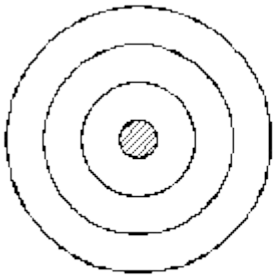
(1)

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

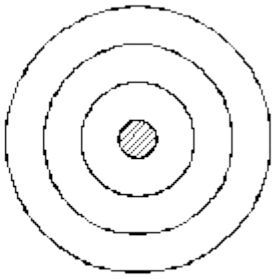
_____(aq) + _____(aq) → _____(aq) + _____(l)

(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?

_____

(1)

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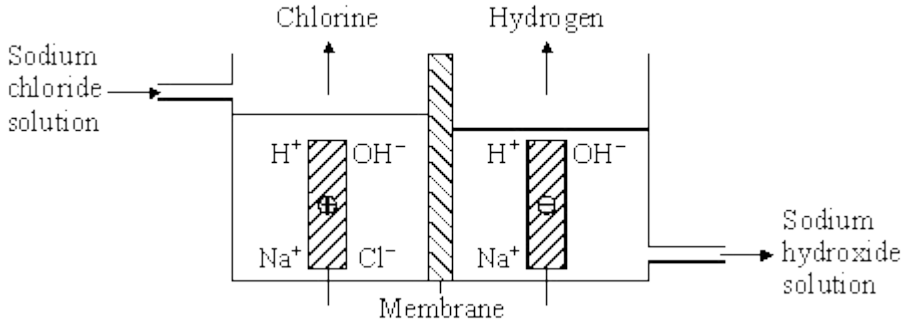
(iii) Why do these sodium and chloride particles bond?

_____

_____

(1)

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



Describe how each of these products are formed.

_____

_____

_____

_____

_____

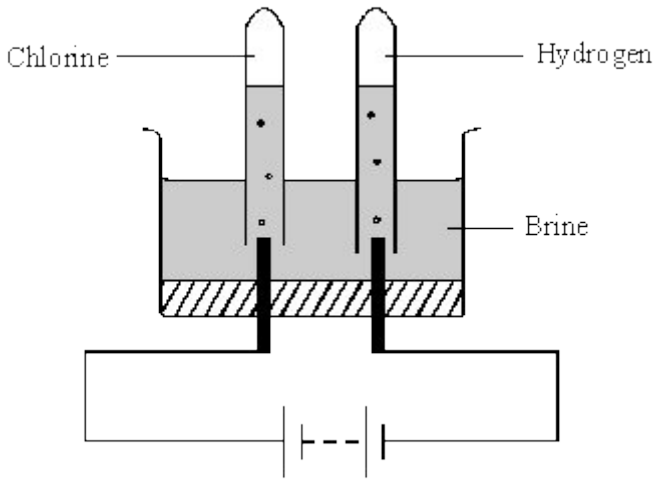
_____

(3)

(Total 15 marks)

Q18.

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.



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(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 $^{35}_{17}C1$ and $^{37}_{17}C1$ to explain the meaning of the term *isotopes.*

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

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Q19.

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

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

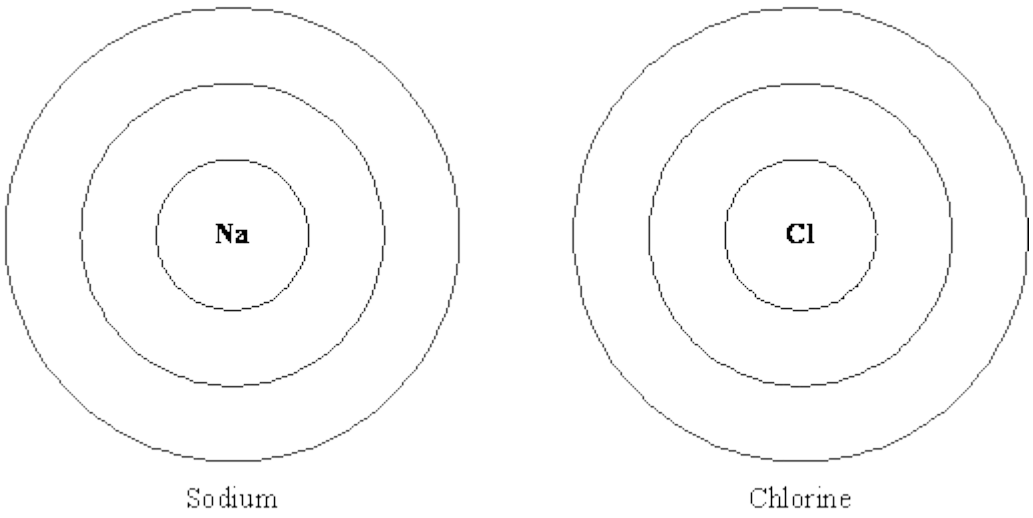


(a) Balance the symbol equation for the reaction of sodium with chlorine.

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

(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.

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_____

_____

(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:

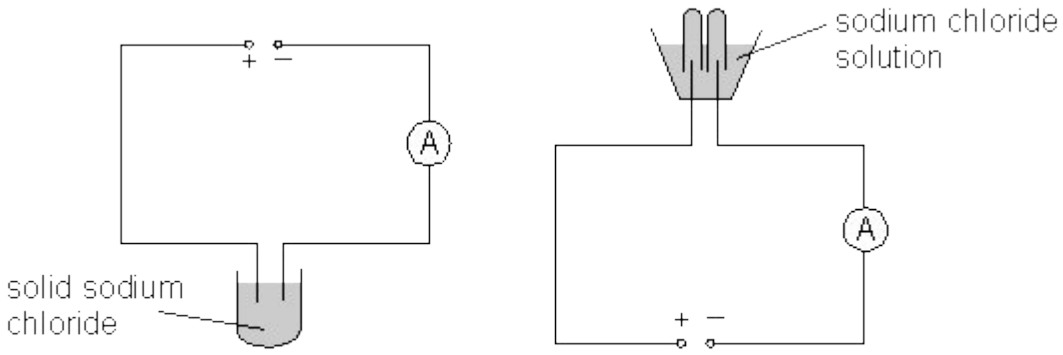
(ii) Why the reaction of potassium with chlorine is similar to the reaction of sodium with chlorine.

_____

_____

(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.

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

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

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

(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)

Q20.

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.

_____

(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?

_____

(1)

(d) Fluorine reacts with the non-metal sulphur to make sulphur hexafluoride (SF_6).

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

_____

(1)

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

_____

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_____

_____

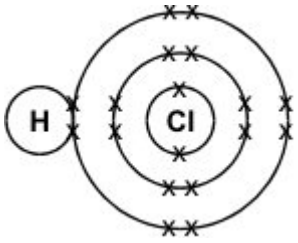
(1)

(Total 5 marks)

Q21.

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.

_____

_____

_____

(3)

(Total 5 marks)

Q22.

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.

Spark Plugs

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

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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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

_____

(2)

(Total 13 marks)

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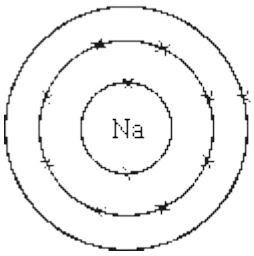
Q23.

(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.



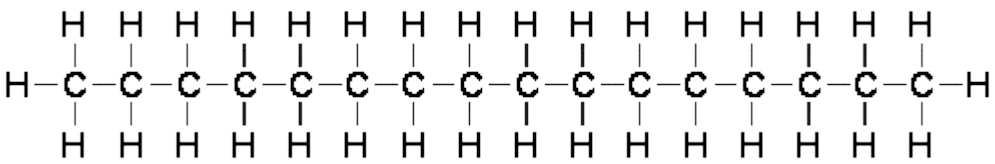
(i) Draw a similar diagram for a fluorine atom.

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

(4)
(Total 5 marks)

Q24.

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?

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_____

(1)

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

What is a covalent bond?

_____

_____

(2)

(Total 3 marks)

Q25.

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.

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(4)

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

_____

_____

_____

_____

(3)

(Total 13 marks)

Q26.

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)

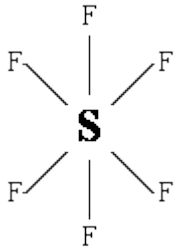
(Total 3 marks)

Q27.

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.

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(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)

Q28.

X is an element with the following properties:

- melts at –220°C and boils at –188°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°C?

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_____

(1)

(b) Predict the formula of the product formed when X reacts with aluminium.
(The aluminium ion is Al^{3+} and the X ion is X^{-}.)
Select your answer from the list below.

AlX **AlX_2** **AlX_3** **Al_3X** **Al_2X_3**

Predicted formula _____

(1)

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

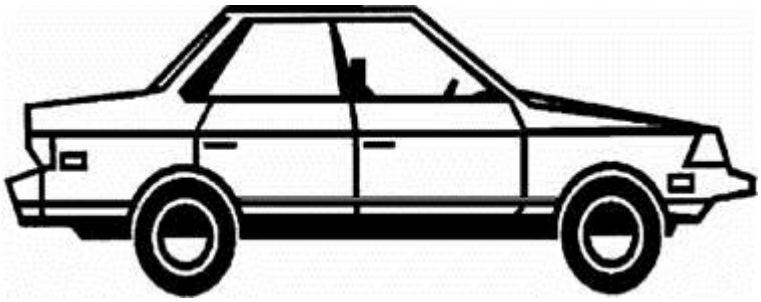
_____

(1)

(Total 3 marks)

Q29.

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;

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_____

(2)

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

_____

(1)

(iii) gives the body panels strength.

_____

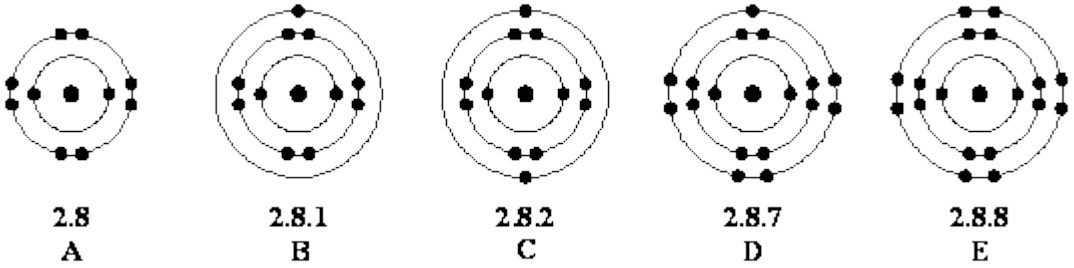
(1)

(Total 8 marks)

Q30.

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 _____

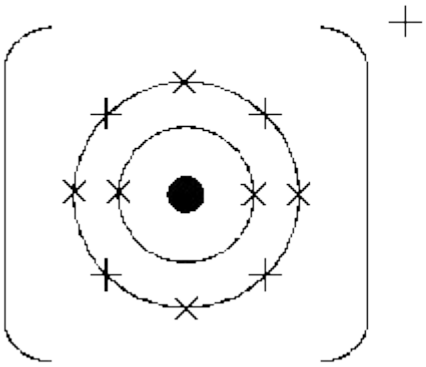
(ii) A sodium ion, Na^+ _____

(Total 2 marks)

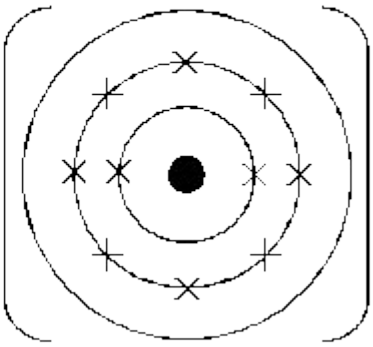
Q31.

Sodium chloride is an ionic compound.

This is a diagram of a sodium ion.



Complete this diagram of a chloride ion.



(Total 2 marks)

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Q32.

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

This equation represents the reaction.

$Mg\ (s) + O_2\ (g) \rightarrow MgO\ (s)$

(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)

Q33.

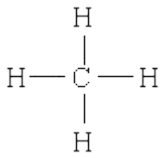
(a) A piece of lithium is placed on the surface of some water in a beaker.
Hydrogen is given off.
Lithium hydroxide is also formed.

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.

_____

_____

_____

_____

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_____

_____

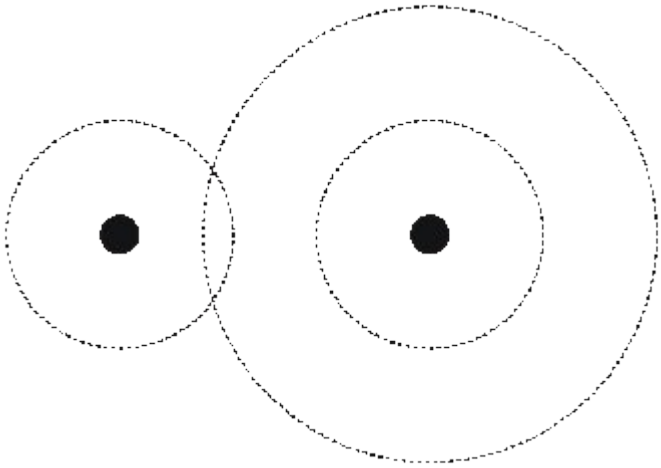
_____

(4)

(Total 6 marks)

Q34.

(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)

Q35.

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

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

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

_____

(1)

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

_____

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(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:

$CH_4 + H_2O \rightarrow 3H_2 + CO$

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?

_____

_____

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(1)
(Total 10 marks)

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