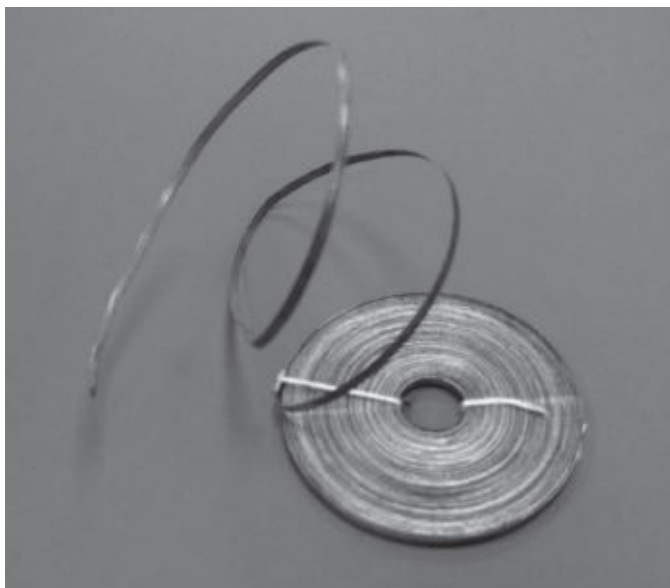


1

- (a) Magnesium metal is shaped to make magnesium ribbon.



Explain why metals can be shaped.

.....

.....

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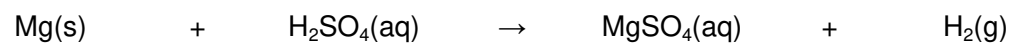
.....

.....

(2)

- (b) Magnesium sulfate is a salt of magnesium.

It can be prepared by the reaction of magnesium metal with an acid. The equation for the reaction of magnesium with this acid is:



- (i) Name the acid used to make magnesium sulfate.

..... acid

(1)

- (ii) Use the equation to help you to describe what you would **observe** when magnesium reacts with the acid.

.....

.....

.....

.....

.....

(2)

- (iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

.....

.....

(1)

(Total 6 marks)

2

Read the information in the box.

Flash powder is used to produce special effects at pop concerts.



Flash powder contains aluminium. The powder burns with a bright white flame and gives out lots of heat and light. It also produces white smoke.

The flash powder is placed on stage in a special container. At the bottom of the container there is a thin piece of wire. When the flash is needed, electricity is passed through the wire. The wire gets hot and starts the aluminium burning.

By russellsmith [CC BY 2.0], via Flickr

- (a) When aluminium burns the reaction is exothermic.

Give **one** piece of information from the box which shows that the reaction is exothermic.

.....

(1)

- (b) The hot wire provides energy to start the aluminium burning.

Draw a ring around the name given to the energy needed to start a chemical reaction.

activation energy

potential energy

solar energy

(1)

- (c) When aluminium burns it reacts with oxygen to make aluminium oxide.

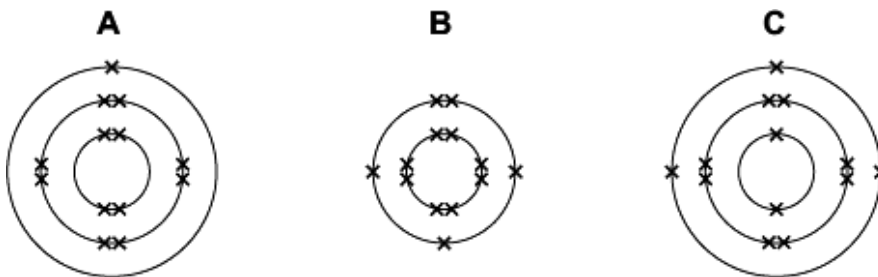
Complete the word equation for this reaction.

aluminium + →

(1)

- (d) An aluminium atom has 13 electrons.

Which diagram, **A**, **B** or **C**, represents the electronic structure of an aluminium atom?



The electronic structure of an aluminium atom is diagram

(1)

- (e) The white smoke produced is aluminium oxide.

Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

Draw a ring around the correct word in each box to complete each sentence.

- (i) Electrons have

a negative
no
a positive

 charge.

(1)

- (ii) When an aluminium atom (Al) turns into an aluminium ion (Al^{3+})

- it

gains
loses
shares

 three electrons.

(1)

- (iii) When an oxygen atom (O) turns into an oxide ion (O^{2-})

- it

gains
loses
shares

one
two
three

 electrons.

(2)
(Total 8 marks)

3

Read the information in the box.

Flash powder is used to produce special effects at pop concerts.



Flash powder contains aluminium. The powder burns with a bright white flame and gives out lots of heat and light. It also produces white smoke.

The flash powder is placed on stage in a special container. At the bottom of the container there is a thin piece of wire. When the flash is needed, electricity is passed through the wire. The wire gets hot and starts the aluminium burning.

By russellsmith [CC BY 2.0], via Flickr

- (a) When aluminium burns the reaction is *exothermic*.

What is the meaning of *exothermic*?

.....

(1)

- (b) The hot wire provides energy to start the aluminium burning.

What is the name given to the heat energy needed to start a chemical reaction?

..... energy

(1)

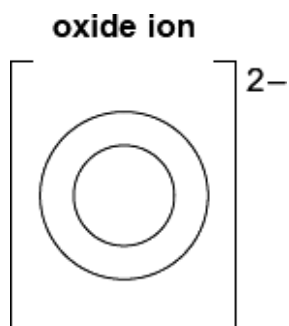
- (c) The white smoke produced is aluminium oxide.

Aluminium oxide contains aluminium ions (Al^{3+}) and oxide ions (O^{2-}).

- (i) Complete the diagram to show the electronic structure of an oxide ion.

The atomic number of oxygen = 8

Use crosses (x) to represent the electrons.



(1)

- (ii) The bonding in aluminium oxide is ionic.

What causes the aluminium ions and oxide ions to be held together strongly?

.....

(1)

(Total 4 marks)

4

Lead compounds have been used for thousands of years as colours in paint.



Johannes Vermeer [Public domain], via Wikimedia Commons

- (a) A sample of a red oxide used in paint was found to contain 6.21 g of lead and 0.64 g of oxygen.

Calculate the empirical (simplest) formula of this compound.

You **must** show all your working to gain full marks.

Relative atomic masses: O = 16; Pb = 207.

.....

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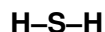
.....

.....

(4)

- (b) A problem with lead compounds is that they slowly react with hydrogen sulfide in the air. This produces lead sulfide which is black.

- (i) Hydrogen sulfide has the formula H_2S . The bonding in a molecule of hydrogen sulfide can be represented as:

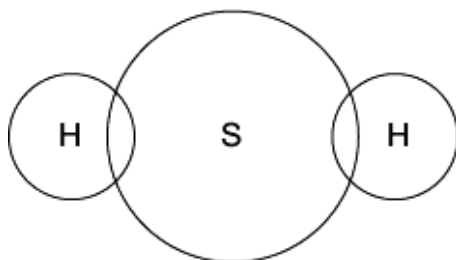


Complete the diagram below to show the arrangement of the outer electrons of the hydrogen and sulfur atoms in hydrogen sulfide.

Use dots (•) and crosses (x) to represent the electrons.

You need only show the outer shell electrons.

(Atomic numbers: H = 1; S = 16.)



(1)

- (ii) Hydrogen sulfide has a low boiling point.

Explain why.

.....

.....

.....

.....

(2)

- (iii) Lead white is also used in paint. The white colour slowly darkens when lead sulfide is produced.

The painting can be restored with hydrogen peroxide. This converts the black lead sulfide into white lead sulfate.

Balance the equation for the reaction between lead sulfide and hydrogen peroxide (H_2O_2).



(1)

(Total 8 marks)

5

Natural gas is mainly a hydrocarbon called methane.

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

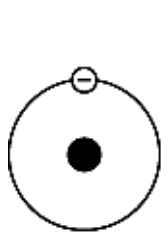
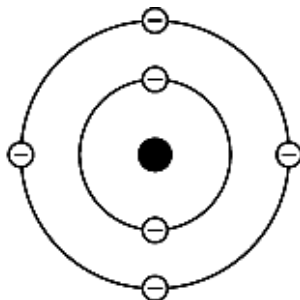
compounds**elements****molecules**

Hydrocarbons contain hydrogen and carbon only.

Hydrogen and carbon are

(1)

- (b) The diagrams represent atoms of hydrogen and carbon.

**Hydrogen****Carbon**

Draw a ring around the correct answer to complete the sentences.

- (i) The centre of each atom is called the

bond.

nucleus.

symbol.

(1)

- (ii) The hydrogen atom has one electron and the carbon atom has

three

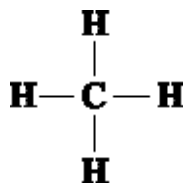
four

six

electrons.

(1)

- (c) A molecule of methane can be represented as



Draw a ring around the correct answer to complete the sentences.

- (i) The formula of methane is

CH

CH₄

C₄H₄

(1)

- (ii) The line between C—H is called a

bond.

molecule.

nucleus.

(1)

- (d) Methane burns to produce carbon dioxide (CO₂) and water (H₂O).

- (i) Draw a ring around the correct answer to complete the sentence.

When methane burns it reacts with

carbon.

nitrogen.

oxygen.

(1)

- (ii) Hydrogen (H₂) can be used as a fuel.

Suggest why burning hydrogen would be less harmful to the environment than burning methane.

.....

.....

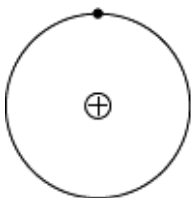
(1)
(Total 7 marks)

6

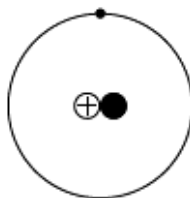
Two isotopes of hydrogen are hydrogen-1 (${}^1_1\text{H}$) and hydrogen-2 (${}^2_1\text{H}$).

The diagrams represent atoms of hydrogen-1 and hydrogen-2.

Hydrogen-1



Hydrogen-2



(a) Use the correct words from the box to complete the sentences.

electrons

neutrons

protons

(i) The positive particles, \oplus , in the nucleus of atoms are called

.....

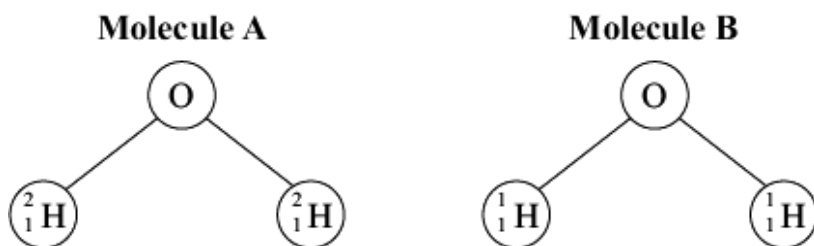
(1)

(ii) The particles with no charge, \bullet , in the nucleus of atoms are called

.....

(1)

- (b) The diagrams show two different types of water molecule.



Draw a ring around the correct answer to complete the sentence.

Molecule **A**
is

heavier than

lighter than

the same mass as

molecule **B**.

Explain your answer.

.....

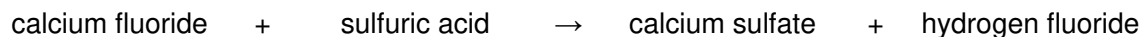
.....

(2)
(Total 4 marks)

7

Hydrogen fluoride is used to make hydrofluoric acid.

- (a) A company makes hydrogen fluoride by reacting solid calcium fluoride with sulfuric acid. The reaction takes place in a rotating kiln.



The company want this reaction to take place quickly.

- (i) Rotating the kiln makes the reaction take place faster.

Suggest why.

.....

.....

(1)

- (ii) Draw a ring around the correct word in each box.

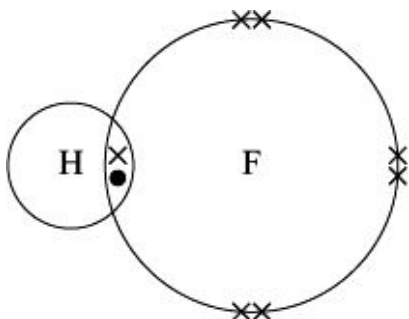
To make the reaction take place **faster**:

the temperature should be	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> higher lower </div>	so that the particles have	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> less more </div>	energy
the solid calcium fluoride should be	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> powder lumps </div>	to give a	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> small big </div>	surface area
the sulfuric acid solution should be	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> dilute concentrated </div>	to give	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> less more </div>	collisions

between the particles each second.

(3)

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



The hydrogen and fluorine atoms are joined by a covalent bond.

Use the correct word from the box to complete the sentence.

electrons	neutrons	protons
-----------	----------	---------

In a covalent bond the atoms share

(1)

- (c) Hydrogen fluoride is dissolved in water to make an acidic solution of hydrofluoric acid.

Draw a ring around the symbol of the ion that makes the solution acidic.

H^+

OH^-

F^-

(1)
(Total 6 marks)

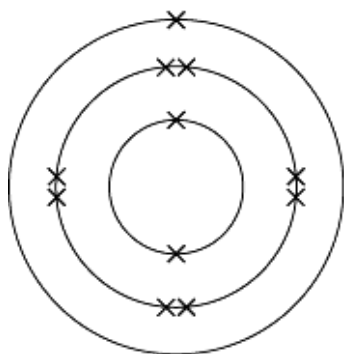
8

Sodium chloride is a raw material.

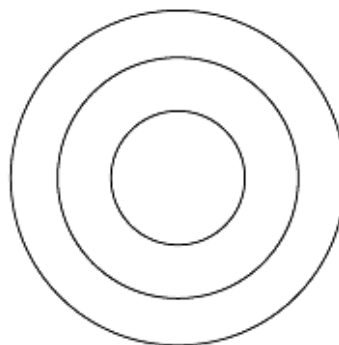
- (a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

Sodium atom



Chlorine atom



(1)

- (b) When sodium and chlorine react to form sodium chloride they form sodium ions (Na^+) and chloride ions (Cl^-).

How does a sodium atom change into a sodium ion?

.....

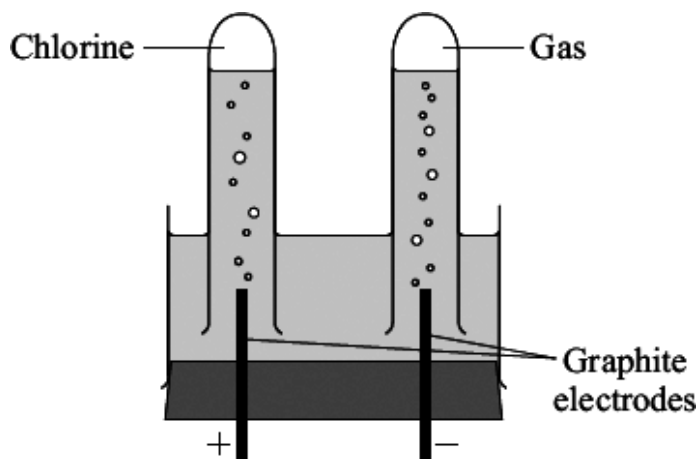
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(2)

- (c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions (Na^+), chloride ions (Cl^-), hydrogen ions (H^+) and hydroxide ions (OH^-).

- (i) Why do chloride ions move to the positive electrode?

.....

(1)

- (ii) Name the gas formed at the negative electrode.

.....

(1)

- (d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

Local people have been protesting outside a paper factory. They say:
'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'

The company replied:
'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

- (i) Why are some local people worried about the use of chlorine compounds?

.....

.....

(1)

- (ii) Why might other local people want the company to continue to use chlorine compounds?

.....

(1)

- (iii) It is decided to have an inquiry.
 Why should this be done by independent scientists?

.....

(1)
 (Total 8 marks)

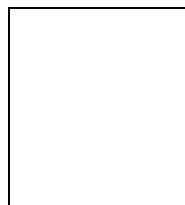
9

- (a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

	Hydrogen-1	Hydrogen-2
Atomic number	1	1
Mass number	1	2

An atom of hydrogen-1 is represented as: ${}^1_1\text{H}$

Show how an atom of hydrogen-2 is represented.



(1)

- (b) (i) Calculate the relative formula mass (M_r) of water, H_2O

Relative atomic masses: $\text{H} = 1$; $\text{O} = 16$.

.....

Relative formula mass (M_r) =

(1)

- (ii) Simple molecules like water have low boiling points.

Explain why, in terms of molecules.

.....

.....

.....

.....

(2)

- (c) Molecules of heavy water contain two atoms of hydrogen-2 instead of two atoms of hydrogen-1.

Explain why a molecule of heavy water has more mass than a normal water molecule. You should refer to the particles in the nucleus of the two different hydrogen atoms in your answer.

.....

.....

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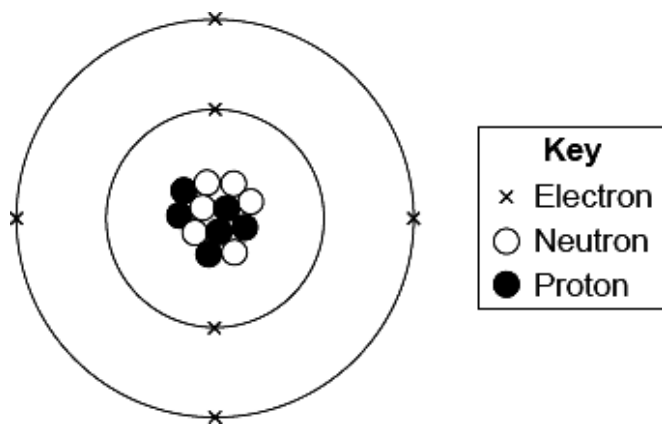
.....

(2)

(Total 6 marks)

10

The diagram represents a carbon atom.



(a) Use words from the box to answer the questions.

electron**neutron****nucleus****proton**

(i) What is the name of the central part of the atom?

.....

(1)

(ii) What is the name of the particle with no charge?

.....

(1)

(iii) What is the name of the particle with a negative charge?

.....

(1)

(b) Use the diagram above to help you to answer these questions.

(i) Draw a ring around the atomic (proton) number of this carbon atom.

6**12****18**

(1)

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

6**12****18**

(1)

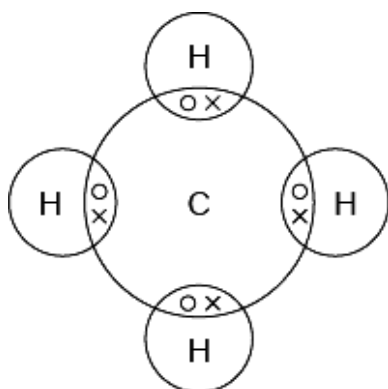
(c) A different carbon atom has 6 protons and 8 neutrons.

Draw a ring around the symbol that represents this atom.

 ${}^8_6\text{C}$ ${}^{14}_6\text{C}$ ${}^{14}_8\text{C}$

(1)

- (d) The diagram shows the bonding in a methane molecule.



- (i) Draw a ring around the chemical formula of a methane molecule.

CH₄

CH⁴

C₄H

(1)

- (ii) Draw a ring around the word that describes methane.

compound

element

mixture

(1)

- (iii) Draw a ring around the type of bonding in a methane molecule.

covalent

ionic

metallic

(1)

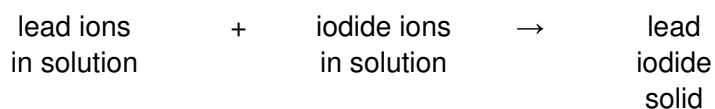
(Total 9 marks)

11

This question is about lead iodide and magnesium iodide.

- (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a solid.



- (i) Draw a ring around the name given to this type of reaction.

electrolysis

neutralisation

precipitation

(1)

- (ii) Tick (✓) the method used to separate solid lead iodide from the solution.

Method	Tick (✓)
distillation	
evaporation	
filtration	

(1)

- (iii) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you to:

draw a ring around a soluble compound which contains lead ions

lead bromide

lead chloride

lead nitrate

draw a ring around a soluble compound which contains iodide ions.

lead iodide

silver iodide

sodium iodide

(2)

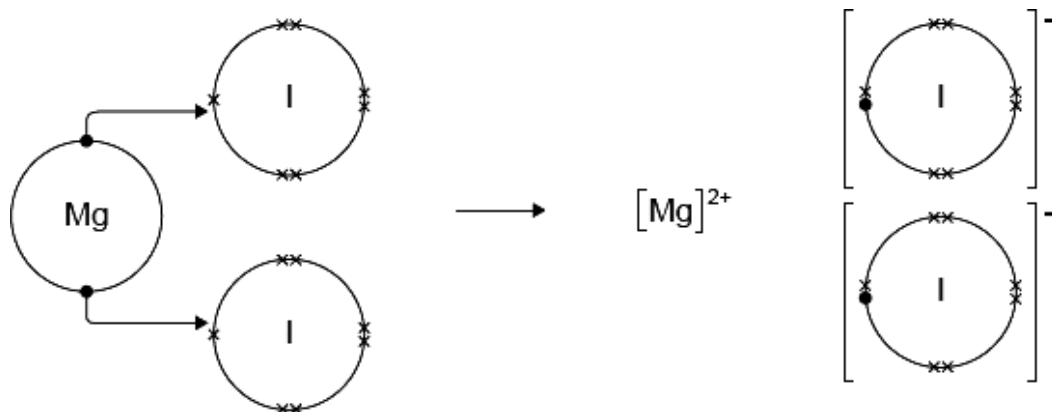
- (b) Magnesium iodide can be made by reacting magnesium with iodine.



The diagram shows how this takes place.

Only the outer electrons are shown.

The dots (●) and crosses (×) are used to represent electrons.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

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(4)
(Total 8 marks)

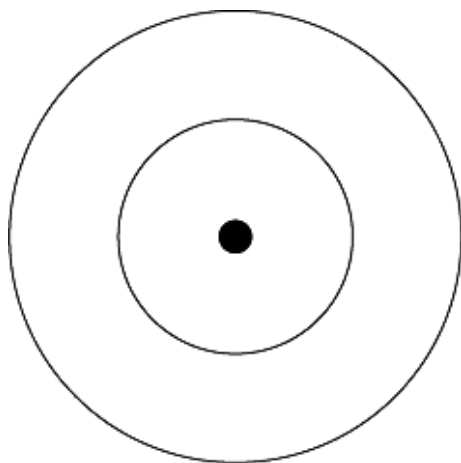
12

Pure carbon can exist in two forms, diamond and graphite.

- (a) Complete the diagram to show the electronic structure of a carbon atom.

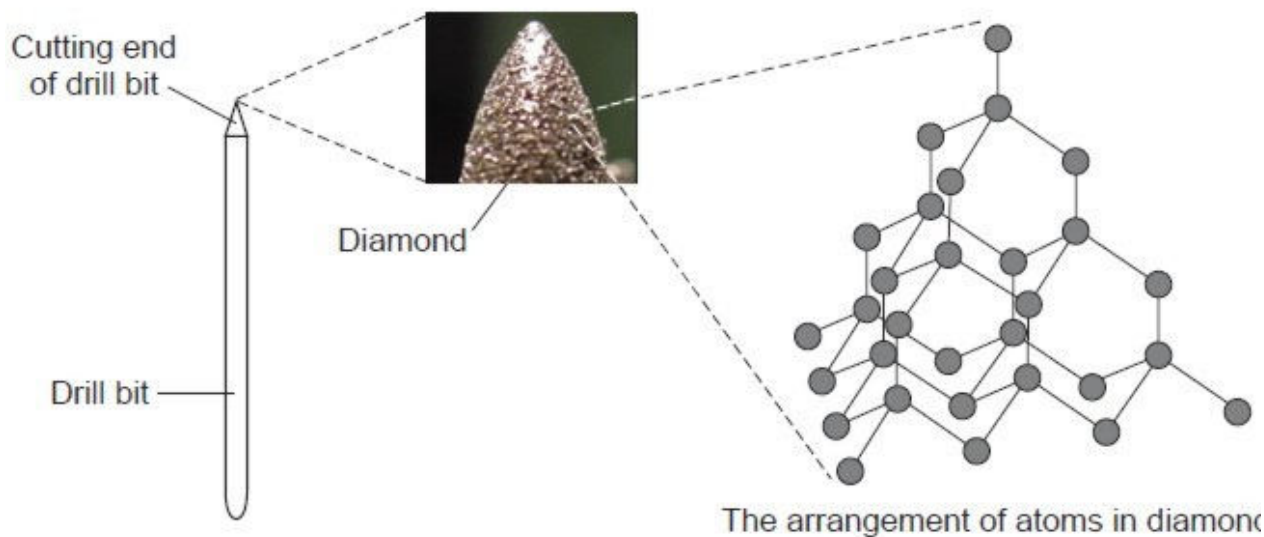
A carbon atom has 6 electrons.

Show the electrons as crosses (x).



(1)

- (b) A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



By Wanderlinse [CC By 2.0], via Flickr

- (i) What property of diamond makes it suitable for use on the cutting end of a drill bit?

.....

(1)

- (ii) Explain, as fully as you can, why diamond has this property. Use your knowledge of the structure and bonding of diamond and the information shown opposite to help you to answer this question.

.....

.....

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.....

(3)

- (c) Explain why graphite is a good conductor of electricity and why diamond does **not** conduct electricity.

.....

.....

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.....

.....

.....

.....

(3)

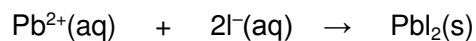
(Total 8 marks)

13

This question is about some compounds of iodine.

- (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a precipitate.



- (i) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you name:

a soluble compound which contains lead ions

a soluble compound which contains iodide ions

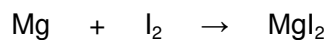
(2)

- (ii) Suggest a method of separating the lead iodide from the solution.

.....

(1)

- (b) Magnesium iodide can be made by reacting magnesium with iodine.



Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^-).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

.....

.....

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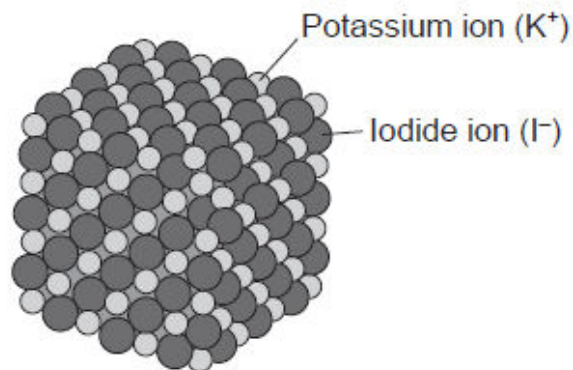
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(4)

- (c) The diagram shows the structure of potassium iodide.



Explain why a high temperature is needed to melt potassium iodide.

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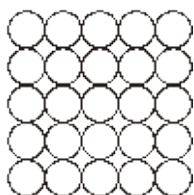
.....

(2)
(Total 9 marks)

14

Iron is the main structural metal used in the world.

- (a) The diagram represents the particles in iron, Fe.



Draw a ring around the correct word in the box to complete the sentence.

Iron is described as an element because all the

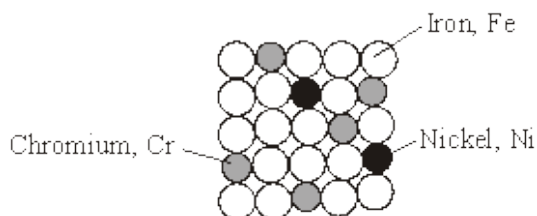
atoms
compounds
metals

are the same.

(1)

- (b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.



Use the correct words from the box to complete the sentences about alloys.

metal	mixture	molecule	polymer	smart	structure
-------	---------	----------	---------	-------	-----------

Stainless steel is an alloy because it is a of iron, chromium and nickel.

An alloy is made up of more than one type of

Stainless steel alloys are harder than iron because the different sized atoms added change the

An alloy that can return to its original shape after being deformed is called a alloy.

(4)

- (c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

- (i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1

.....

2

.....

(2)

- (ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

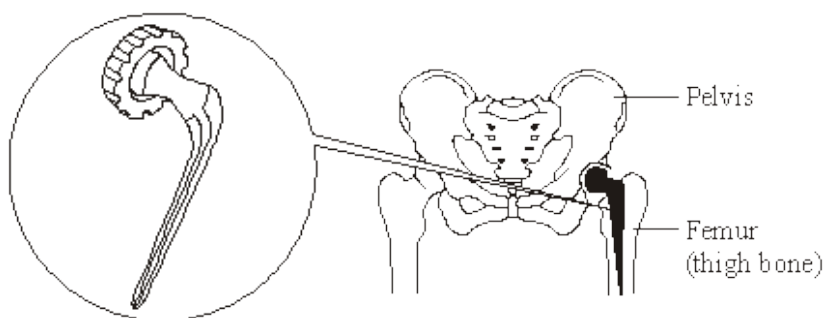
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.....

(1)
(Total 8 marks)

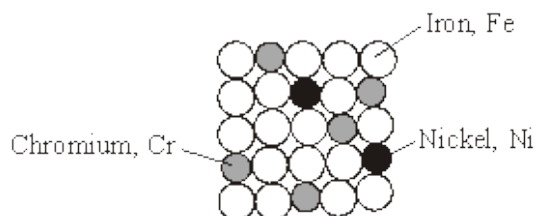
15

The hip joint between the femur and pelvis sometimes has to be replaced. Early hip replacement joints were made from stainless steel.



Stainless steel is an alloy of iron, chromium and nickel.

The diagram below represents the particles in stainless steel.



Particle diagram of stainless steel

- (a) Use the particle diagram to complete the percentages of metals in this stainless steel.

The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	
Nickel, Ni	

(2)

(b) Pure iron is a relatively soft, metallic element.

(i) Why is iron described as an *element*?

.....
.....

(1)

(ii) Suggest why pure iron would **not** be suitable for a hip replacement joint.

.....
.....

(1)

(iii) Use the particle diagram to help you to explain why stainless steel is harder than pure iron.

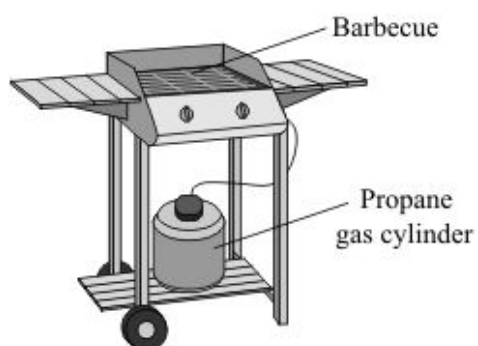
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(2)

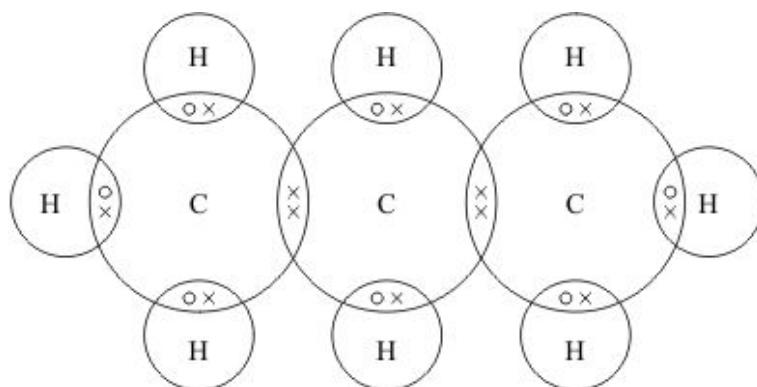
(Total 6 marks)

16

This barbecue burns propane gas.



The diagram represents a propane molecule.



(a) What is the formula of propane?

(1)

(b) (i) Draw a ring around the name of the particle represented by the symbols \circ and \times in the diagram.

electron

neutron

proton

(1)

(ii) Draw a ring around the type of bonding that holds the atoms together in a propane molecule.

covalent

ionic

metallic

(1)

(c) Under high pressure in the cylinder propane is a liquid.
Liquid propane evaporates easily to form a gas when the tap on the cylinder is opened.

Draw a ring around the correct answer in each box to explain why propane evaporates easily.

Propane has a	high low	boiling point because it consists of	large small	molecules.
---------------	-------------	--------------------------------------	----------------	------------

(1)

(Total 4 marks)

17

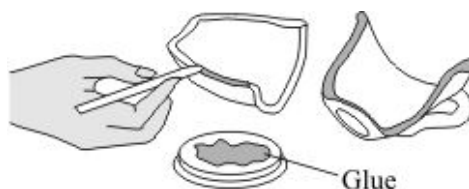
The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

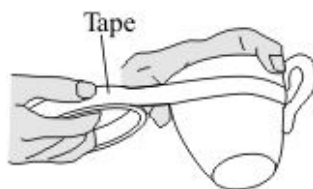


Step 2 Mix the liquids to make the glue.

Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Assemble the pieces to be joined and then hold them together with tape.



Step 4 Leave the glue to set.

(a) When liquids **A** and **B** are mixed a chemical reaction takes place.

(i) This reaction is exothermic.

Complete the sentence below using a word or phrase from the box.

decrease	increase	stay the same
----------	----------	---------------

During the reaction the temperature of the mixture will

(1)

(ii) When the glue sets it forms a giant covalent structure.

Draw a ring around **one** property that you would expect the set glue to have.

good conductor of electricity

low melting point

high melting point

(1)

- (b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in °C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

- (i) Complete the sentences below using words or phrases from the box.

decrease	increase	stay the same
-----------------	-----------------	----------------------

When the temperature is increased the time taken for the glue to set

.....

When the temperature is increased the rate of the setting reaction

.....

(2)

- (ii) Put a tick (✓) next to the **two** reasons why an increase in temperature affects the rate of reaction.

Reason	(✓)
It gives the particles more energy.	
It increases the concentration of the particles.	
It increases the surface area of the particles.	
It makes the particles move faster.	

(2)
(Total 6 marks)

18

Iron is an essential part of the human diet. Iron(II) sulfate is sometimes added to white bread flour to provide some of the iron in a person's diet.



- (a) The formula of iron(II) sulfate is FeSO_4

Calculate the relative formula mass (M_r) of FeSO_4

Relative atomic masses: O = 16; S = 32; Fe = 56.

.....

The relative formula mass (M_r) =

(2)

- (b) What is the mass of one mole of iron(II) sulfate? Remember to give the unit.

.....

(1)

- (c) What mass of iron(II) sulfate would be needed to provide 28 grams of iron?

Remember to give the unit.

.....

(1)

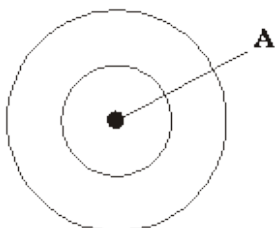
(Total 4 marks)

19

This question is about oxygen atoms. The periodic table on the Data Sheet may help you to answer this question.

- (a) (i) Oxygen atoms have 8 electrons.

Complete the diagram to represent the arrangement of electrons in an oxygen atom.
Use crosses (×) to represent the electrons.



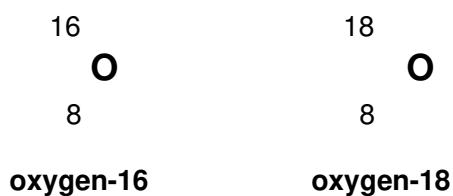
(1)

- (ii) Name the part of the oxygen atom that is labelled **A** on the diagram.

.....

(1)

- (b) Two isotopes of oxygen are oxygen-16 and oxygen-18.



Explain, in terms of particles, how the nucleus of an oxygen-18 atom is different from the nucleus of an oxygen-16 atom.

.....

.....

.....

.....

(2)

(Total 4 marks)

20

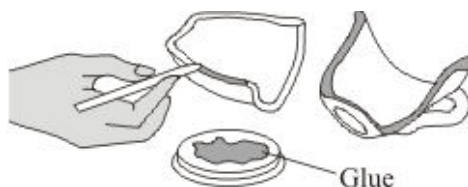
The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

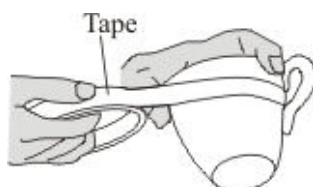


Step 2 Mix the liquids to make the glue.

Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Assemble the pieces to be joined and then hold them together with tape.



Step 4 Leave the glue to set.

(a) When liquids **A** and **B** are mixed a chemical reaction takes place.

(i) This reaction is exothermic.

State how the temperature of the mixture will change as the glue is mixed.

.....

(1)

(ii) When the glue sets it forms a giant covalent structure.

Explain why substances with giant covalent structures have high melting points.

.....

(2)

- (b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in °C	Time taken for the glue to set
20	3 days
60	6 hours
90	1 hour

Explain, in terms of particles, why increasing the temperature changes the rate of the reaction which causes the glue to set.

.....

.....

.....

.....

.....

(2)
(Total 5 marks)

21

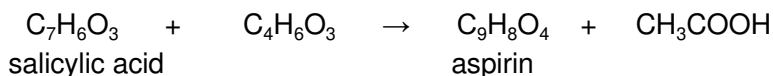
Aspirin tablets have important medical uses.



A student carried out an experiment to make aspirin. The method is given below.

1. Weigh 2.00 g of salicylic acid.
2. Add 4 cm³ of ethanoic anhydride (an excess).
3. Add 5 drops of concentrated sulfuric acid.
4. Warm the mixture for 15 minutes.
5. Add ice cold water to remove the excess ethanoic anhydride.
6. Cool the mixture until a precipitate of aspirin is formed.
7. Collect the precipitate and wash it with cold water.
8. The precipitate of aspirin is dried and weighed.

(a) The equation for this reaction is shown below.



Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.

The relative formula mass (M_r) of salicylic acid, $\text{C}_7\text{H}_6\text{O}_3$, is 138

The relative formula mass (M_r) of aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is 180

.....

Maximum mass of aspirin = g

(2)

(b) The student made 1.10 g of aspirin from 2.00 g of salicylic acid.

Calculate the percentage yield of aspirin for this experiment.

(If you did not answer part (a), assume that the maximum mass of aspirin that can be made from 2.00 g of salicylic acid is 2.50 g. This is **not** the correct answer to part (a).)

.....

Percentage yield of aspirin = %

(2)

- (c) Suggest **one** possible reason why this method does **not** give the maximum amount of aspirin.

.....

(1)

- (d) Concentrated sulfuric acid is a catalyst in this reaction.

Suggest how the use of a catalyst might reduce costs in the industrial production of aspirin.

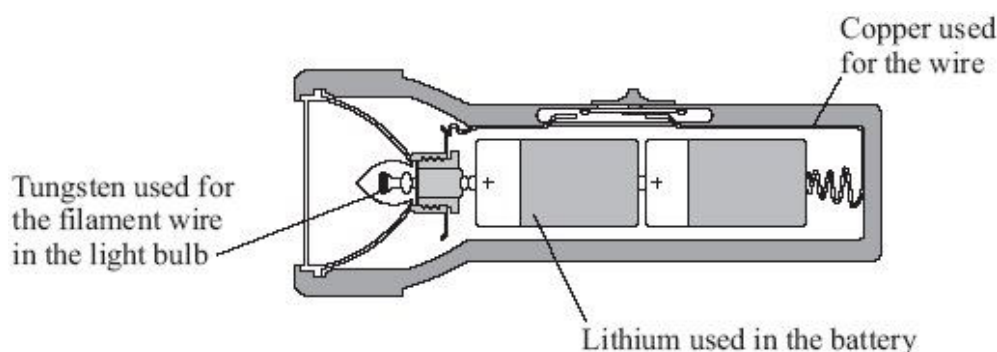
.....

(1)

(Total 6 marks)

22

The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

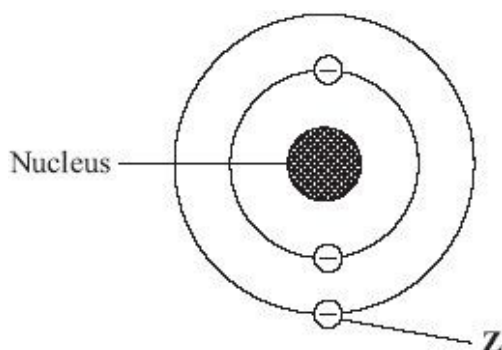


- (a) Why is copper used for the wire?

.....

(1)

- (b) The diagram shows the structure of an atom of lithium.



Name the particle labelled **Z**.

.....

(1)

- (c) The table shows some properties of the metals used in the electrical circuit.

Metal	Melting point in °C	Boiling point in °C	Reaction with oxygen
Copper	1083	2582	Reacts slowly to form a thin oxide layer on surface
Lithium	179	1317	Reacts rapidly to form oxide
Tungsten	3370	5930	Reacts only when very hot to form oxide

- (i) Use information from the table to suggest the order of reactivity for copper, lithium and tungsten.

most reactive

.....

least reactive

(2)

- (ii) The filament wire glows because it gets very hot.

Use information from the table to suggest **one** reason why tungsten is used for the filament wire in the light bulb.

.....

.....

(1)

- (d) The gas used in the light bulb is argon.

Draw a ring around the correct word in the box to complete the sentence.

Argon is used in the light bulb because it is

dense. solid. unreactive.

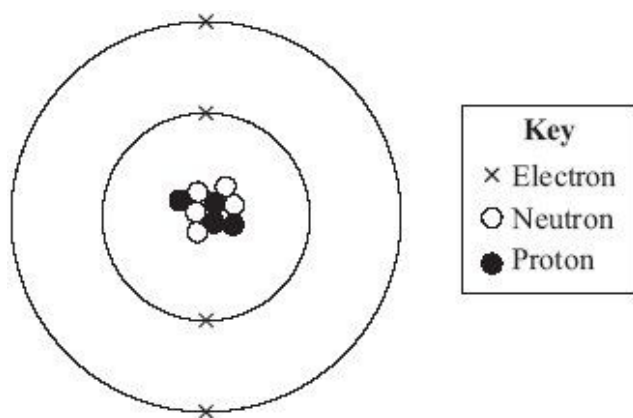
.

(1)

(Total 6 marks)

23

The diagram represents an atom of beryllium.



Use a number from the box to complete each sentence.

4 7 9 12

(a) The atomic number (proton number) of this atom is .

(1)

(b) The mass number of this atom is .

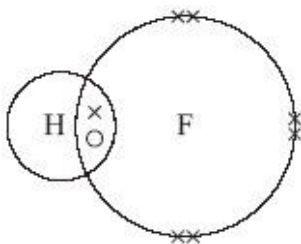
(1)

(Total 2 marks)

24

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 (✓)
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.

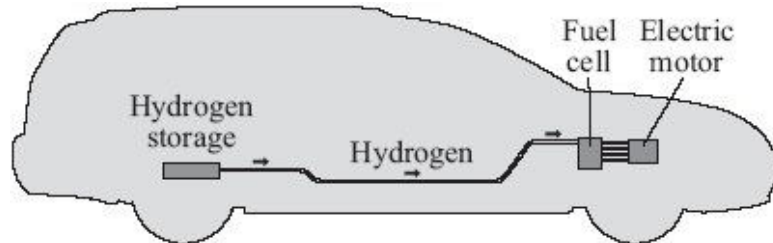
.....

(1)

(Total 5 marks)

Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. On combustion it reacts with oxygen from the air to release a large amount of energy. The only product of combustion is water which does not cause pollution. 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. Hydrogen stored in lithium nitride will not explode.

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. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

(a) Use information from the article to help you to answer these questions.

(i) Give **two** reasons why hydrogen is an excellent fuel.

- 1
-
- 2
-

(2)

(ii) Hydrogen stored in lithium nitride is safer in an accident than a cylinder full of hydrogen gas.

State why.

-
-

(1)

- (iii) What is the advantage of using 'nanosized' particles of lithium nitride instead of normal sized particles for storing hydrogen?

.....

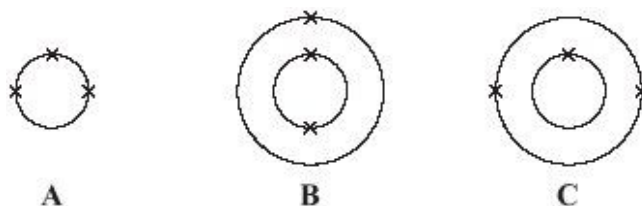
.....

(1)

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

- (i) The periodic table on the Data Sheet may help you to answer this question.

Which diagram, **A**, **B** or **C**, represents the electronic structure of a lithium atom?
Write your answer in the box.



Diagram

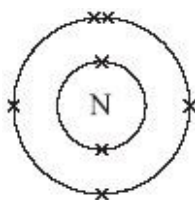
(1)

- (ii) Tick (✓) the statement which describes how a lithium atom (Li) changes into a lithium ion (Li^+).

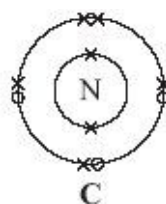
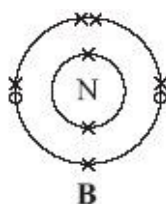
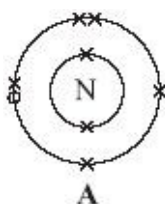
Statement	Tick (✓)
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(1)

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



Which diagram, **A**, **B** or **C**, represents the electronic structure of a nitride ion (N^{3-})?
Write your answer in the box.



Diagram

(1)

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



What does the symbol \rightleftharpoons mean?

Draw a ring around your answer.

reversible reaction

endothermic reaction

neutralisation

(1)

- (d) Draw a ring around the correct answer in each box to complete the sentences.

- (i) 'Nanosized' particles of lithium nitride will be

much larger

a little larger

much smaller

than normal sized particles of lithium nitride.

(1)

- (ii) One of the reasons why 'nanosized' particles have different properties

from normal sized particles is that they have a greater

density
mass
surface area

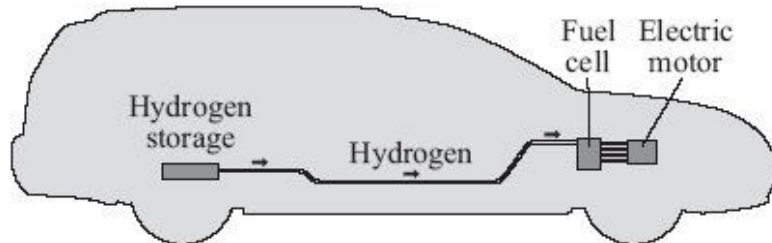
than normal sized particles of lithium nitride.

(1)
(Total 10 marks)

26

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?

.....

.....

.....

(1)

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

Explain why hydrogen gas is formed but not potassium.

.....

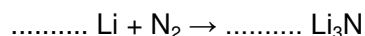
.....

.....

(1)

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

Balance the equation for this reaction.



(1)

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



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.

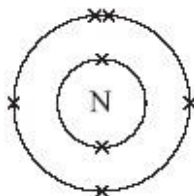
Explain why.

.....

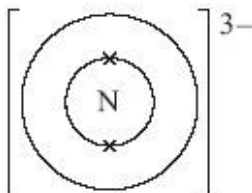
.....

(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-}).

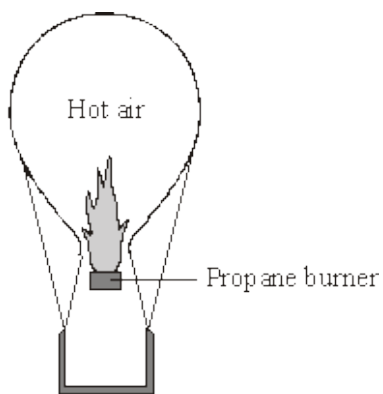


(1)

(Total 8 marks)

27

Hot air balloons burn hydrocarbons to heat the air.



- (a) The hot air contains these gases: nitrogen, N_2
 oxygen, O_2
 argon, Ar
 carbon dioxide, CO_2
 water vapour, H_2O

- (i) Argon is an *element*.

What is an *element*?

.....

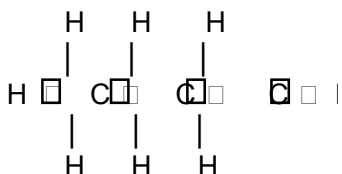
(1)

- (ii) Name **one** other gas in the hot air that is also an element.

.....

(1)

- (b) Propane, C_3H_8 , can be represented as:



Use the correct words from the box to complete the sentences.

bond	carbon	compound	element	mixture
------	--------	----------	---------	---------

- (i) Propane is a and is made up of atoms of hydrogen
 and

(2)

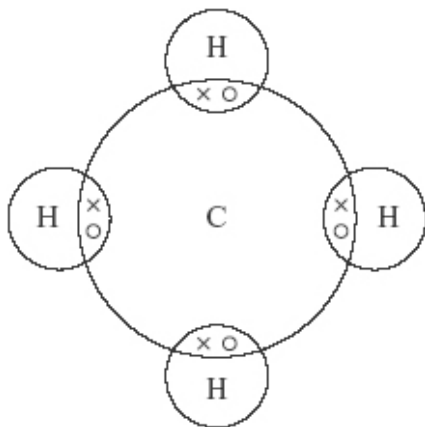
(ii) Each line between the atoms in propane represents a chemical

(1)

(Total 5 marks)

28

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?

.....

(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)



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

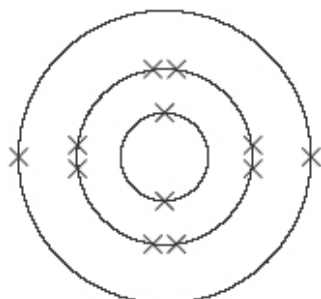
stores heat

takes in heat

An *exothermic* reaction is one which

(1)

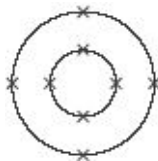
- (b) The diagram shows the electronic structure of a magnesium atom.
The atomic (proton) number of magnesium is 12.



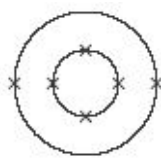
Magnesium atom

The atomic (proton) number of oxygen is 8.

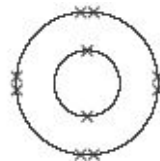
Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?



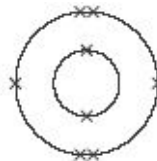
A



B



C

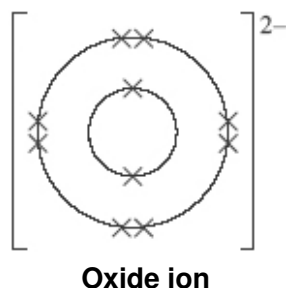


D

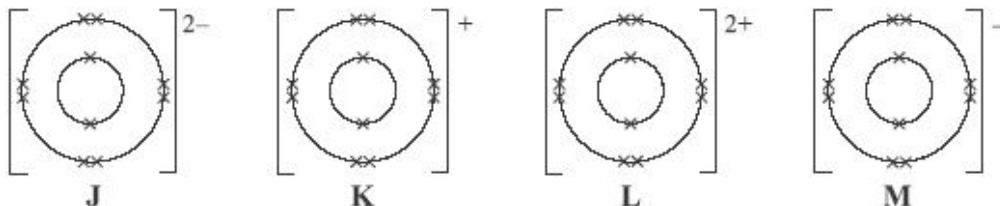
Diagram

(1)

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



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)

30

- (a) A chemist was asked to identify a nitrogen compound. The chemist carried out an experiment to find the relative formula mass (M_r) of the compound.

The M_r of the compound was **44**.

Relative atomic masses: N = 14, O = 16

Draw a ring around the formula of the compound.

NO

NO₂

N₂O₄

N₂O

(1)

- (b) Potassium nitrate is another nitrogen compound. It is used in fertilisers. It has the formula **KNO₃**.

The **M_r** of potassium nitrate is **101**.

Calculate the percentage of **nitrogen** by mass in potassium nitrate.

Relative atomic mass: N = 14.

.....
.....

Percentage of nitrogen = %

(2)

(Total 3 marks)

31

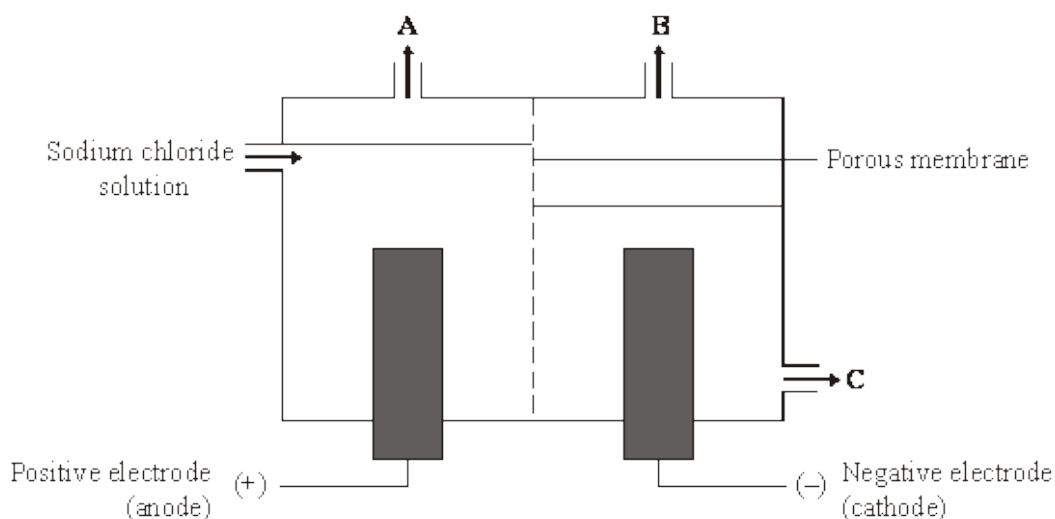
The *electrolysis* of sodium chloride solution produces useful substances.

- (a) Explain the meaning of *electrolysis*.

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

(2)

- (b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



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The electrolysis produces two gases, chlorine and Gas **A**.

Name Gas **A**

(1)

- (c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

.....

(2)

(Total 5 marks)

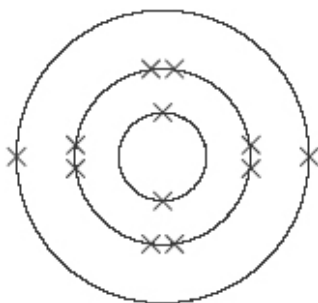
32

- (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.



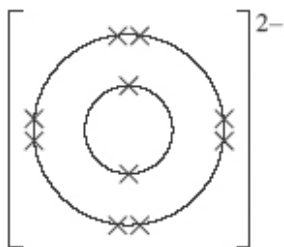
Magnesium atom

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)

- (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)

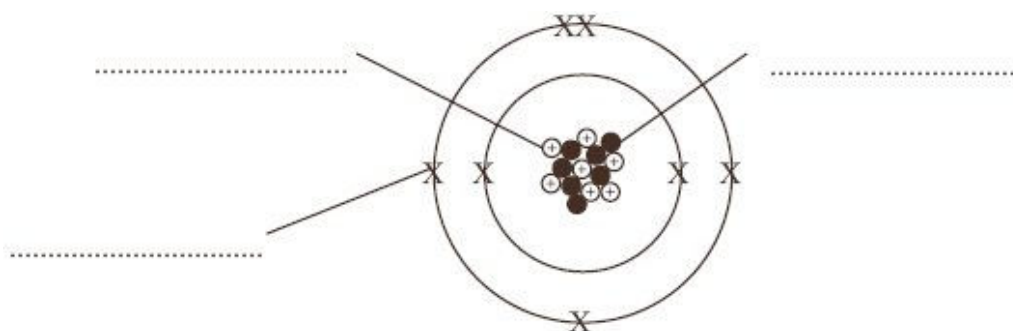
(Total 6 marks)

33

- (a) The diagram represents an atom of nitrogen.

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

electron	neutron	nucleus	proton
----------	---------	---------	--------



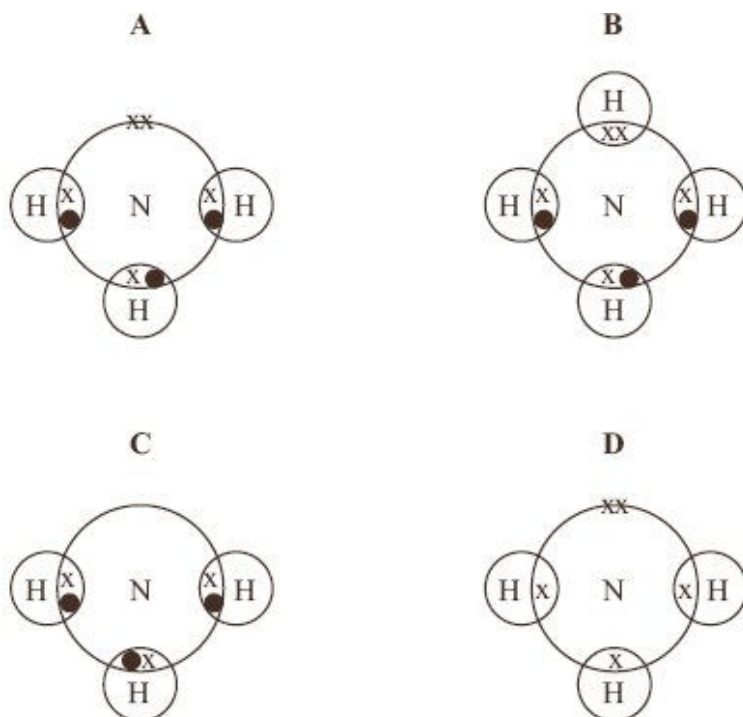
(2)

- (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 .



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

(1)
(Total 4 marks)

34

- (a) Read the article about the use of nanoparticles in sun creams.

Sun creams

Many sun creams use nanoparticles. These sun creams are very good at absorbing radiation, especially ultraviolet radiation. Owing to the particle size, the sun creams spread more easily, cover better and save money because you use less. The new sun creams are also transparent, unlike traditional sun creams which are white. The use of nanoparticles is so successful that they are now used in more than 300 sun cream products.

Some sun creams contain nanoparticles of titanium oxide. Normal-sized particles of titanium oxide are safe to put on the skin.

It is thought that nanoparticles can pass through the skin and travel around the body more easily than normal-sized particles. It is also thought that nanoparticles might be toxic to some types of cell, such as skin, bone, brain and liver cells.

- (i) How is the size of nanoparticles different from normal-sized particles of titanium oxide?

.....

(1)

- (ii) Suggest how the size of nanoparticles might help them to enter the body more easily.

.....

.....

(1)

- (b) Give **two** advantages of using nanoparticles in sun creams.

1

.....

2

.....

(2)

- (c) Why might nanoparticles be dangerous inside the body?

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.....

(1)

(Total 5 marks)

35

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.

.....

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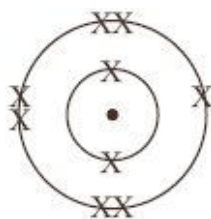
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Mass of fluorine = g

(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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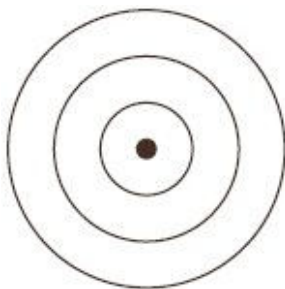
(2)
(Total 7 marks)

36

Aluminium is a useful metal.

- (a) The atomic number (proton number) of aluminium is 13.

Complete the diagram to show the electronic structure of an aluminium atom.
Use crosses (x) to represent the electrons.



(1)

- (b) Aluminium is used as the electrical conductor for overhead power cables.



Explain why metals are good conductors of electricity.

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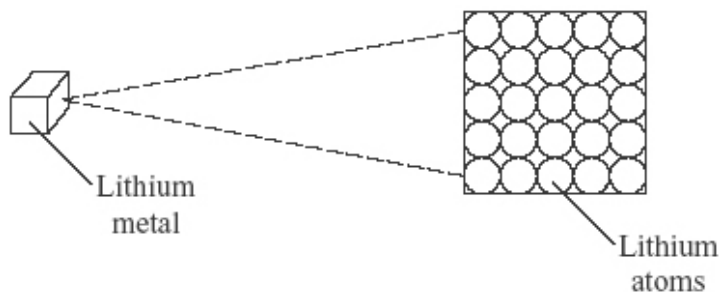
.....

(2)
(Total 3 marks)

37

Lithium metal is used in alkaline batteries.

- (a) The diagram shows the atoms in lithium metal.



Why is lithium metal described as an element?

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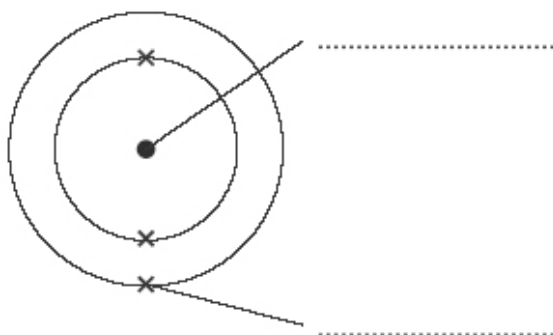
.....

(1)

- (b) The diagram below represents a lithium atom.

Choose words from the box to label parts of the atom.

bond	electron	molecule	nucleus
-------------	-----------------	-----------------	----------------



(2)
(Total 3 marks)

38

John Dalton wrote these statements in 1808.

- “All substances are made of a vast number of extremely small particles called atoms.”
- “Every particle of water is like every other particle of water, every particle of hydrogen is like every other particle of hydrogen, etc.”

- (a) “Every particle of water is like every other particle of water.” Use Dalton's ideas and your knowledge of water to explain why.

.....

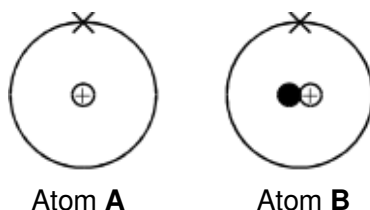
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(2)

- (b) Dalton thought that all atoms of an element are exactly the same. We now know that it is possible to have atoms of the same element but with different mass numbers. The diagrams represent two atoms of hydrogen.



State, in terms of particles, how these two atoms are different.

.....

.....

(1)
(Total 3 marks)

39

Iron ore contains iron oxide.

- (i) Calculate the relative formula mass of iron oxide, Fe_2O_3 .

Relative atomic masses: O = 16; Fe = 56.

.....

.....

Answer =

(2)

- (ii) Calculate the percentage by mass of iron in iron oxide.

.....

Percentage of iron = %

(2)

- (iii) Calculate the mass of iron that could be extracted from 1000 kg of iron oxide.

Use your answer to part (c) (ii) to help you with this calculation.

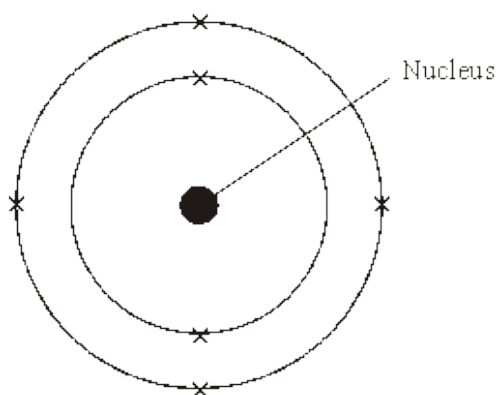
.....

Mass of iron = kg

(1)
(Total 5 marks)

40

The diagram represents the electronic structure of an atom of an element.



The periodic table on the Data Sheet may help you with this question.

- (a) Name this element.

.....

(1)

- (b) Complete this sentence.

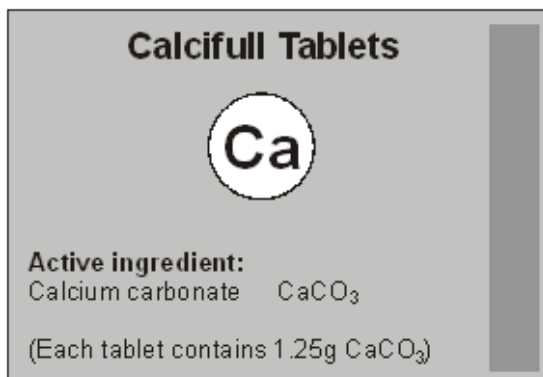
The nucleus of an atom contains neutrons and

(1)

(Total 2 marks)

41

Calcium carbonate tablets are used to treat people with calcium deficiency.



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

Relative atomic masses: C = 12; O = 16; Ca = 40.

.....

.....

Relative formula mass =

(2)

- (b) Calculate the percentage of calcium in calcium carbonate, CaCO_3 .

.....

Percentage of calcium = %

(2)

- (c) Calculate the mass of calcium in each tablet.

.....

Mass of calcium = g

(2)

- (d) An unwanted side effect of this medicine is that it can cause the patient to have 'wind' (too much gas in the intestine).

The equation below represents the reaction between calcium carbonate and hydrochloric acid (the acid present in the stomach).



Suggest why the patient may suffer from 'wind'.

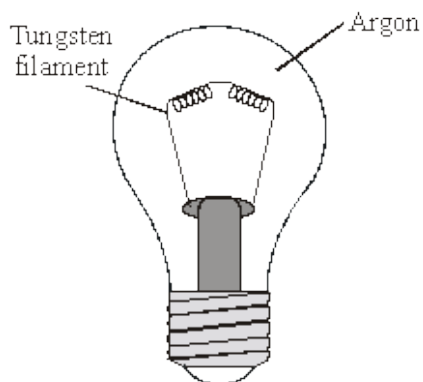
.....

(1)

(Total 7 marks)

42

The diagram shows an electric light bulb.



When electricity is passed through the tungsten filament it gets very hot and gives out light.

- (a) What reaction would take place if the hot tungsten was surrounded by air?

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(1)

- (b) State why argon is used in the light bulb. Explain your answer in terms of the electronic structure of an argon atom.

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(3)

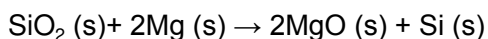
(Total 4 marks)

43

Silicon is an important element used in the electronics industry.

- (a) Silicon can be made by heating a mixture of sand (silicon dioxide) with magnesium powder.

The equation for this reaction is shown below.



Calculate the mass of silicon dioxide needed to make 1 g of silicon.

Relative atomic masses: O = 16; Si = 28

.....

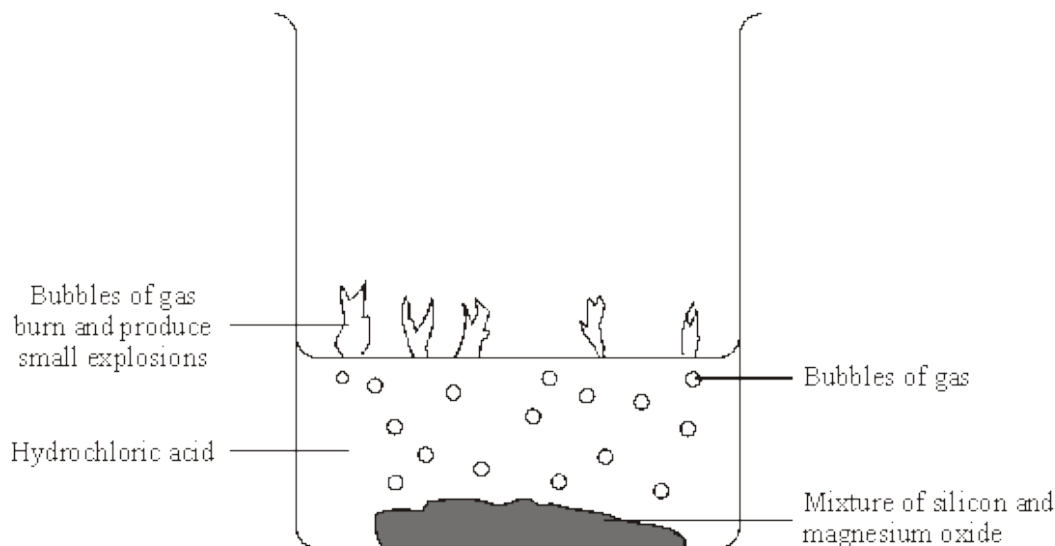
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Mass =g

(3)

- (b) The resulting mixture of magnesium oxide and silicon is added to a beaker containing hydrochloric acid. The silicon is then filtered from the solution.



- (i) The magnesium oxide reacts with the hydrochloric acid and forms magnesium chloride (MgCl_2) solution and water.

magnesium oxide + hydrochloric acid \rightarrow magnesium chloride solution + water

Write a balanced symbol equation for this reaction, including state symbols.

.....

(2)

- (ii) The gases produced are a mixture of several silicon hydrides.

One of the gases produced in the reaction is the silicon hydride with the formula SiH_4 . The structure of this molecule is similar to methane, CH_4 .

Draw a diagram to show the bonding in a molecule of SiH_4 . Represent the electrons as dots and crosses and only show the outer shell (energy level) electrons.

(1)

- (iii) A sample of a different silicon hydride was found to contain 1.4 g of silicon and 0.15 g of hydrogen.

Calculate the formula of this silicon hydride. You must show all your working to gain full marks.

Relative atomic masses: H = 1; Si = 28

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(4)

- (iv) The silicon hydrides react immediately they come into contact with oxygen in the air. They burst into flames with a small explosion and give out energy.

Which letter, **A** to **H**, best describes this reaction?

Energy involved in breaking and forming bonds	Activation energy	Rate of reaction	Letter
The energy released from forming new bonds is greater than the energy needed to break existing bonds	high	fast	A
		slow	B
	low	fast	C
		slow	D
The energy needed to break existing bonds is greater than the energy released from forming new bonds	high	fast	E
		slow	F
	low	fast	G
		slow	H

Letter

(1)

- (c) The structure of silicon is similar to the structure of diamond.

Describe the structure of silicon and explain why it has a high melting point. You may draw a diagram if this helps.

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(4)

(Total 15 marks)

44

- (a) The diagram represents an atom of beryllium. Use words from the box to label the diagram.

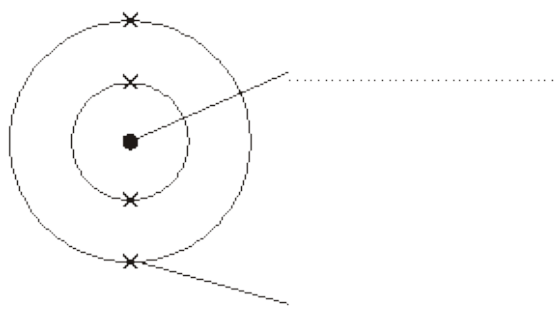
electron

ion

isotope

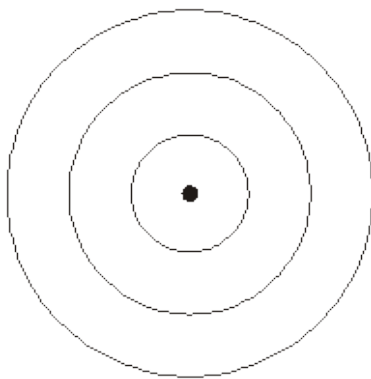
molecule

nucleus



(2)

- (b) Use crosses (x) to complete the diagram to show the electronic structure of a magnesium atom. The atomic (proton) number of magnesium is 12.

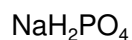


(2)
(Total 4 marks)

45

A student investigated some instant soup.

- (a) Instant soup contains a food additive which has the formula:



Give the names of all the elements in this compound.

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

.....
.....

(2)

- (b) The student investigated the reaction which takes place when soup powder is added to cold water.

The student thought that the reaction might be *exothermic*.

- (i) What is meant by the term *exothermic* reaction?

.....
.....

(2)

- (ii) Describe an experiment that the student could do to prove that this reaction is exothermic.

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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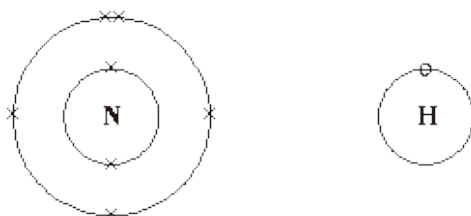
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(4)
(Total 8 marks)

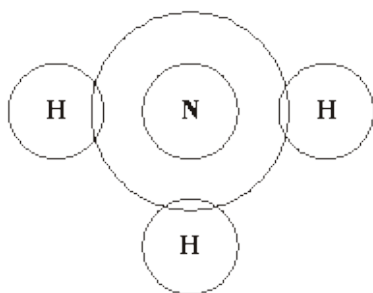
46

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.



(1)

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

.....

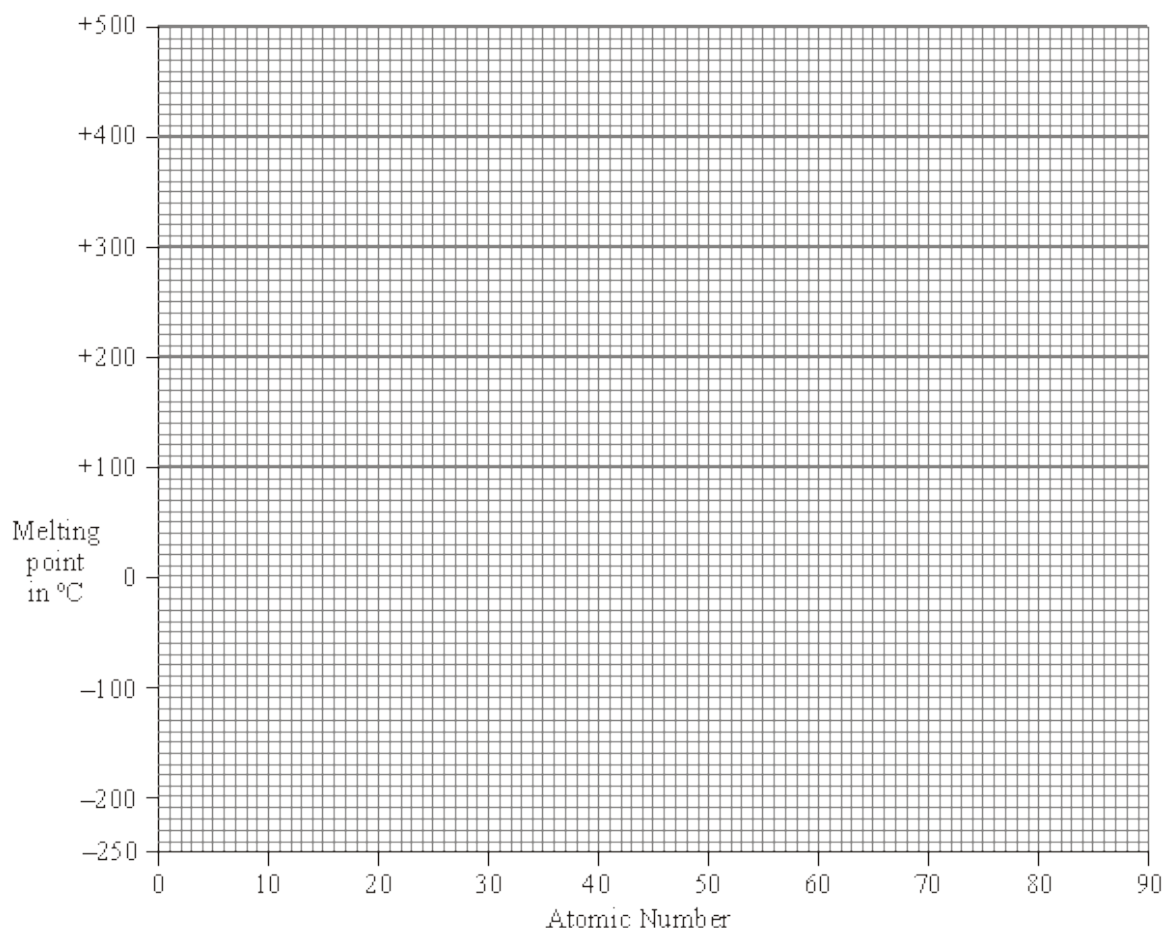
(1)
(Total 2 marks)

47

- (a) The table gives the melting points of some of the elements of Group 7.

Element	Atomic number	Melting point in °C
Fluorine	9	-220
Chlorine	17	-101
Bromine	35	-7
Iodine	53	114
Astatine	85	?

- (i) Plot a graph of the melting point against atomic number.



Draw a line of best fit.

Extend your line to estimate a value for the melting point of astatine.

(2)

(ii) Estimate the melting point of astatine. °C

(1)

(iii) Which of the Group 7 elements are solids at 20 °C?

.....

(1)

(b) (i) Draw a diagram to show the arrangement of electrons in an atom of fluorine.

(1)

(ii) The elements of Group 7 have similar chemical properties.

Explain, in terms of electrons, why they have similar chemical properties.

.....

.....

(1)

(c) Xenon is a very unreactive element.

(i) Explain, in terms of electrons, why xenon is so unreactive.

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(2)

(ii) Fluorine reacts with xenon but iodine does not.

Explain, in terms of atomic structure, why fluorine is more reactive than iodine.

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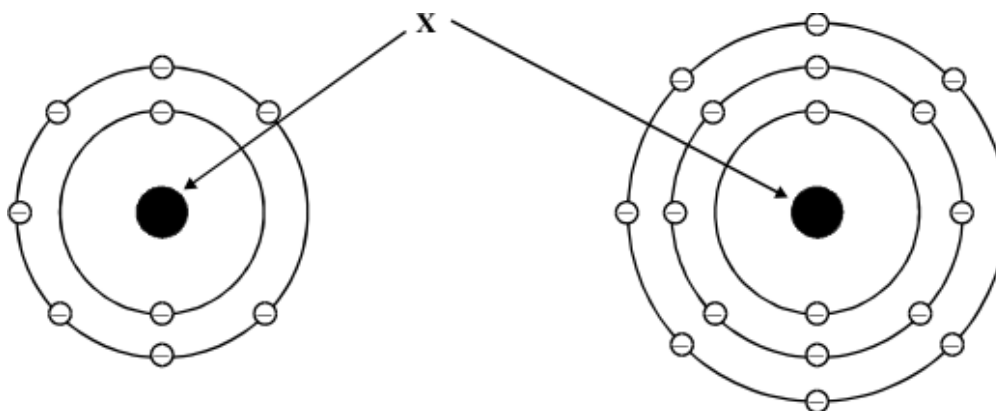
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(3)

(Total 11 marks)

48

The diagrams show the electronic arrangement of the atoms of two elements.



(i) Name the part of the atoms labelled X.

.....

(1)

- (ii) Why are these two elements in the same group of the Periodic Table?

.....

.....

(1)
(Total 2 marks)

49

Fluorine is more reactive than chlorine. Fluorine reacts with most elements in the Periodic Table. However, fluorine does not react with argon.

Atomic numbers: F 9; Cl 17; Ar 18.

- (a) To which group of the Periodic Table do fluorine and chlorine belong?

.....

(1)

- (b) (i) Give **one** use for argon.

.....

(1)

- (ii) Explain why the noble gas argon is unreactive.

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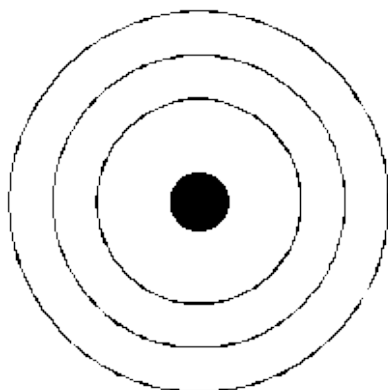
(2)

- (c) (i) Give **one** use for chlorine.

.....

(1)

- (ii) Draw the electron arrangement of a chlorine atom.



(2)

- (iii) Explain why fluorine is more reactive than chlorine.

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(3)

(Total 10 marks)

50

There is molten rock below the Earth's solid outer crust. The rock remains molten because the radioactive decay of isotopes such as uranium, thorium and potassium releases heat energy.

- (i) Explain how this released heat energy is thought to cause the recycling of rocks.

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(4)

- (ii) Two *isotopes* of potassium are shown.



Explain what is meant by *isotopes*. You must include numbers of electrons, neutrons and protons in your explanation.

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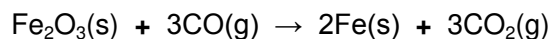
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(4)
(Total 8 marks)

51

The chemical equation for the formation of iron is:



Calculate the relative formula mass of iron oxide, Fe_2O_3 .

Relative atomic masses: O 16; Fe 56.

.....

.....

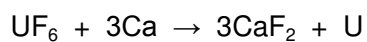
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Relative formula mass $\text{Fe}_2\text{O}_3 = \dots\dots\dots$

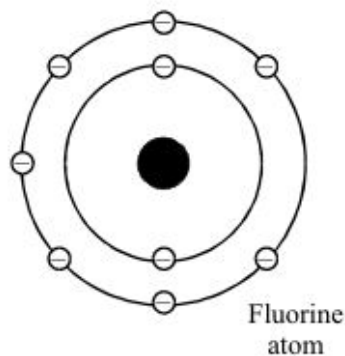
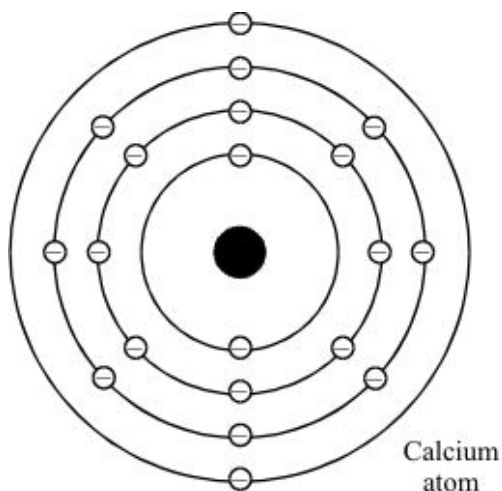
(Total 2 marks)

52

Uranium metal can be produced by reacting uranium hexafluoride with calcium.



- (a) Describe how calcium and fluorine bond together to form calcium fluoride. The electron arrangement of each atom is shown.



.....

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.....

.....

.....

(5)

- (b) Uranium has two main isotopes, ${}_{92}^{235}\text{U}$ and ${}_{92}^{238}\text{U}$. Use these as examples to explain what is meant by the word isotope.

.....

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(4)

- (c) At the start of a reaction there was 174.5 g of uranium hexafluoride, UF_6 .

Relative atomic masses: F 19; U 235

- (i) Calculate the relative formula mass of uranium hexafluoride, UF_6 .

.....

.....

.....

Relative formula mass $\text{UF}_6 = \dots\dots\dots \text{g}$

(1)

- (ii) Calculate the mass of uranium that would be produced from 134.5 g of uranium hexafluoride.

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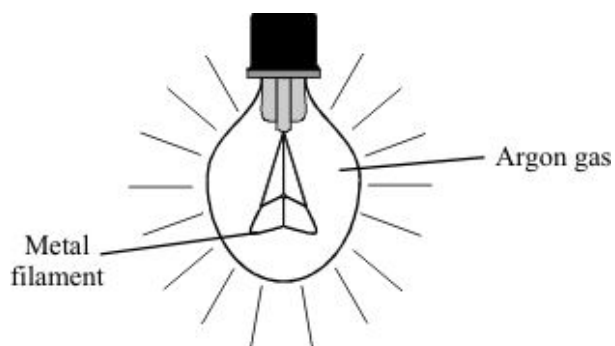
Mass of uranium = $\dots\dots\dots \text{g}$

(2)

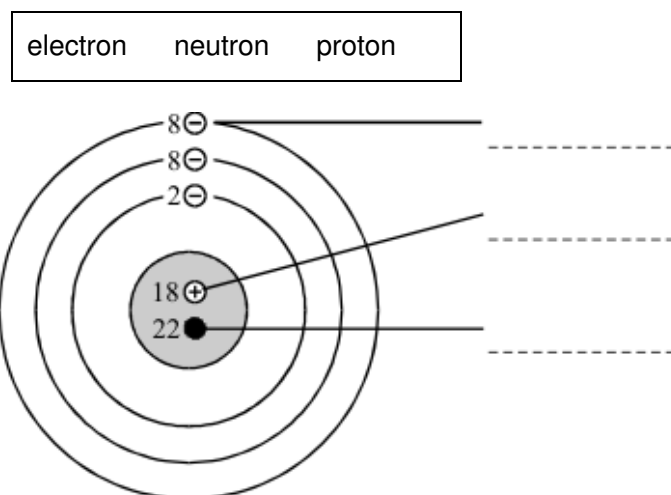
(Total 12 marks)

53

The diagram shows a light bulb.



- (a) (i) An argon atom has the structure shown. Use the words in the box to label the particles in the atom. Each word should only be used **once**.



(2)

- (ii) Argon is unreactive. Why?

.....

(1)

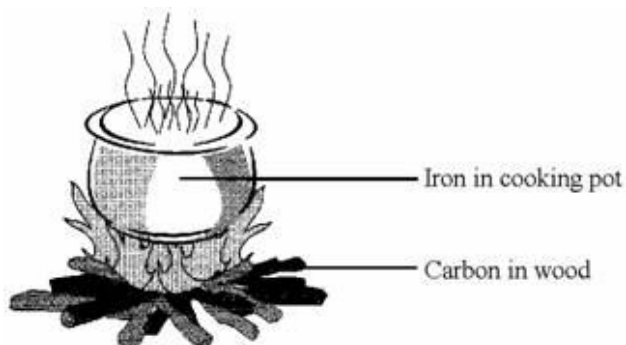
- (b) Oxygen would **not** be a suitable gas to use in a light bulb. Explain why.

.....

(2)

(Total 5 marks)**54**

The uses of *elements* depend on their properties.



- (a) Carbon and iron are both *elements*. What is an *element*?

.....

.....

(1)

- (b) Complete the sentences by crossing out the words that are wrong. The first one has been done for you.

Non-Metals	Metals	can be hammered into shape.
-----------------------	--------	-----------------------------

Non-Metals	Metals	often have low melting point.
------------	--------	-------------------------------

Non-Metals	Metals	are good conductors of heat.
------------	--------	------------------------------

(2)

- (c) In the box are the names of three metals.

copper	iron	sodium
--------	------	--------

Which **one** of these is **not** a good metal for making the cooking pot? Give a reason for your answer.

Metal

Reason

.....

.....

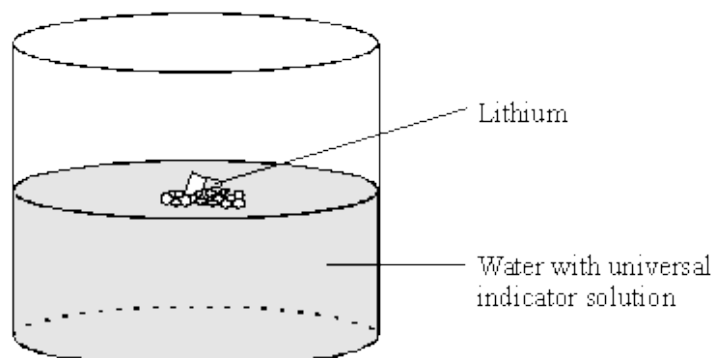
(2)

(Total 5 marks)

55

Lithium is a very reactive metal.

- (a) Lithium reacts with cold water.



- (i) Which **physical** property of lithium is seen during this reaction?

.....

(1)

- (ii) Which **chemical** property of lithium will be shown by the universal indicator?

.....

(1)

- (b) Complete the sentence by writing in the missing numbers.

Lithium has an atomic number of 3 and a mass number of 7.

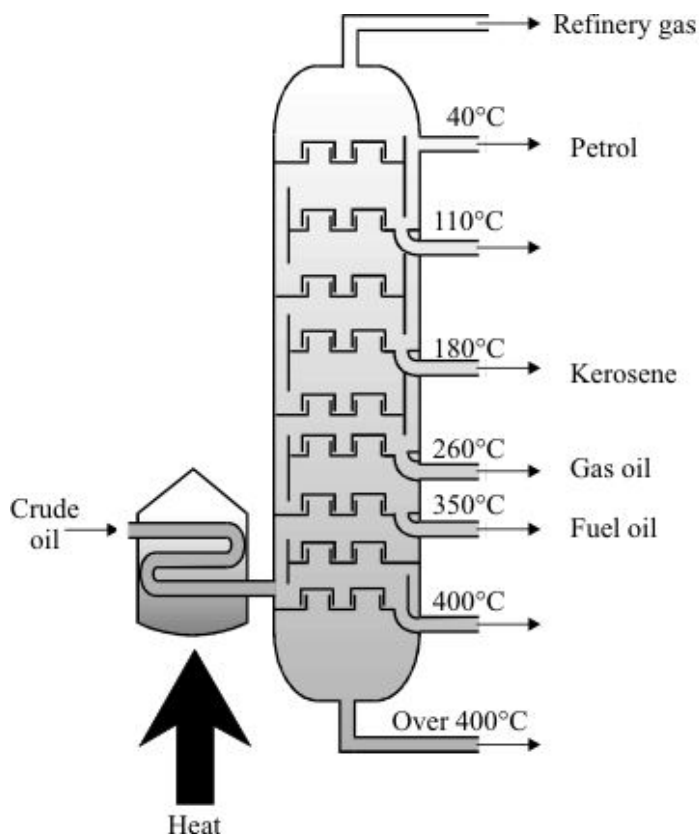
This means that an atom of lithium has protons electrons
and neutrons.

(3)

(Total 5 marks)

56

To make crude oil more useful it is separated into different fractions.



- (a) Complete the gaps in the following sentences.

Crude oil is separated into different fractions by a process called
..... Each fraction has a different

(2)

- (b) Each fraction is a mixture of compounds. Most of these compounds are hydrocarbons, made up of the elements hydrogen and carbon.

- (i) Explain the difference between a mixture and a compound.

.....

.....

.....

(2)

- (ii) Explain the difference between a compound and an element.

.....

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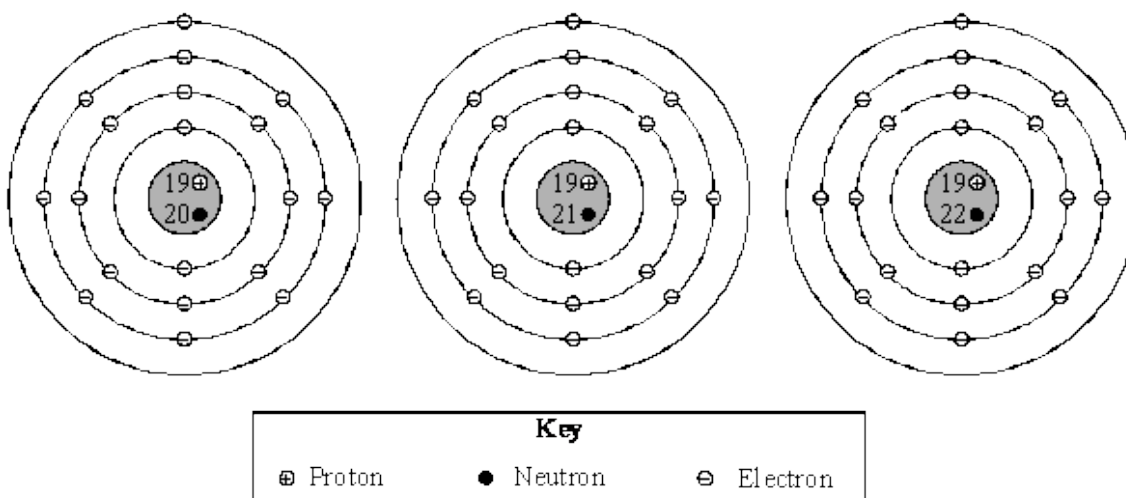
.....

(2)

(Total 6 marks)

57

The diagrams show three *isotopes* of potassium.



- (i) In what way does the atomic structure show you that they are all **atoms**?

.....

.....

(1)

- (ii) Explain why these three atoms are called *isotopes* of potassium.

.....

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.....

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(3)
(Total 4 marks)

58

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

- (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?

.....

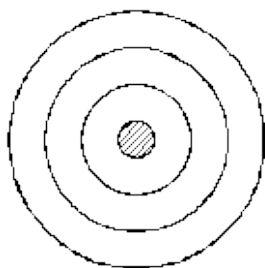
(1)

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

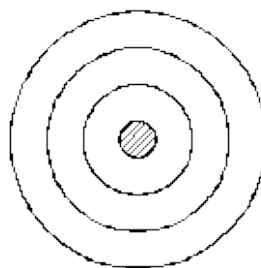
.....(aq) +(aq) →(aq) +(l)

(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)

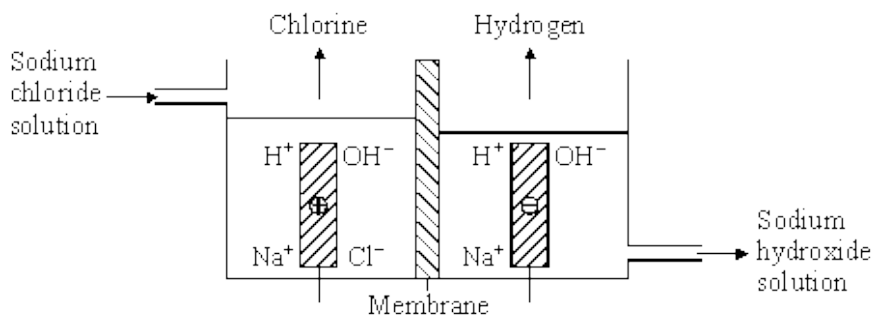
(iii) Why do these sodium and chloride particles bond?

.....

.....

(1)

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



Describe how each of these products are formed.

.....

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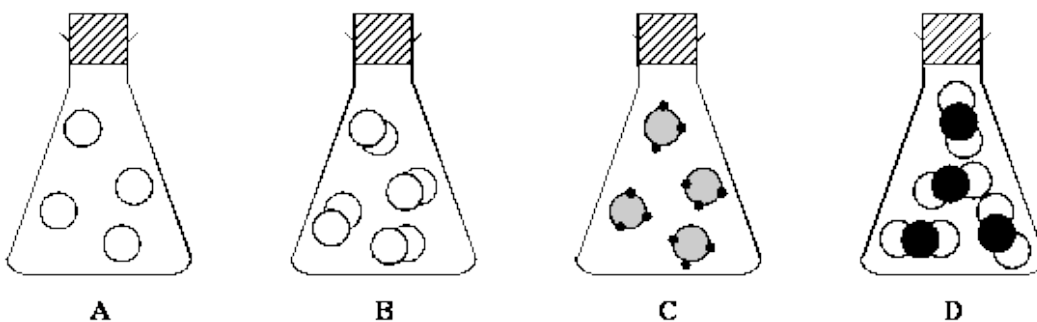
.....

.....

(3)
(Total 15 marks)

59

In the flasks are the particles of four different gases. (Each circle represents an atom.)



(a) Which diagram represents

(i) oxygen, O_2

(1)

(ii) steam, H_2O

(1)

(b) The gases in **A** and **B** are elements and the gases in **C** and **D** are compounds. Explain why.

.....

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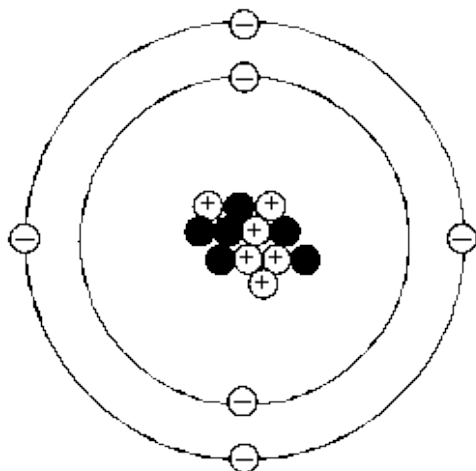
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(3)
(Total 5 marks)

60

About 100 years ago a scientist called J. J. Thomson thought that an atom was a ball of positive charge with negative particles stuck inside. Today a different model is used. The diagram shows how an atom of carbon is represented by this model.



(a) The negative particles \ominus are called electrons.

(i) What is the name of the positive particles \oplus ?

.....

(1)

(ii) What particle is represented by \bullet ?

.....

(1)

(iii) What is the central part of the atom called that contains both \oplus and \bullet ?

.....

(1)

(b) Use the model to explain why the six electrons are arranged as shown.

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(2)

(Total 5 marks)