

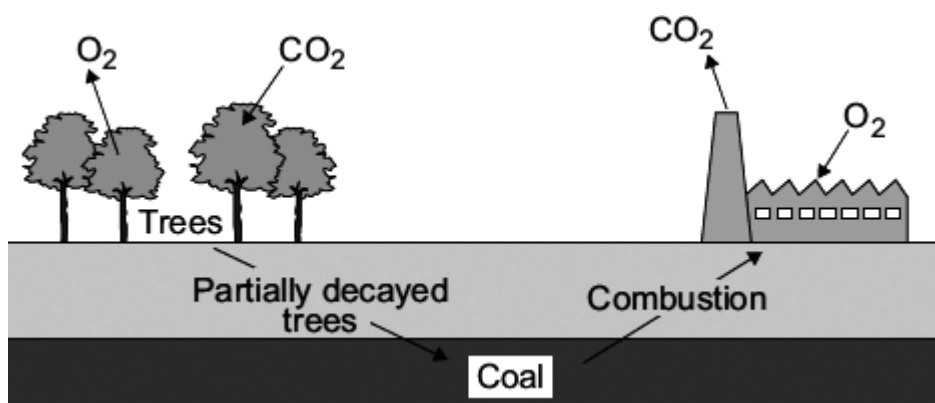
Atomic Structure part 3

Q1.

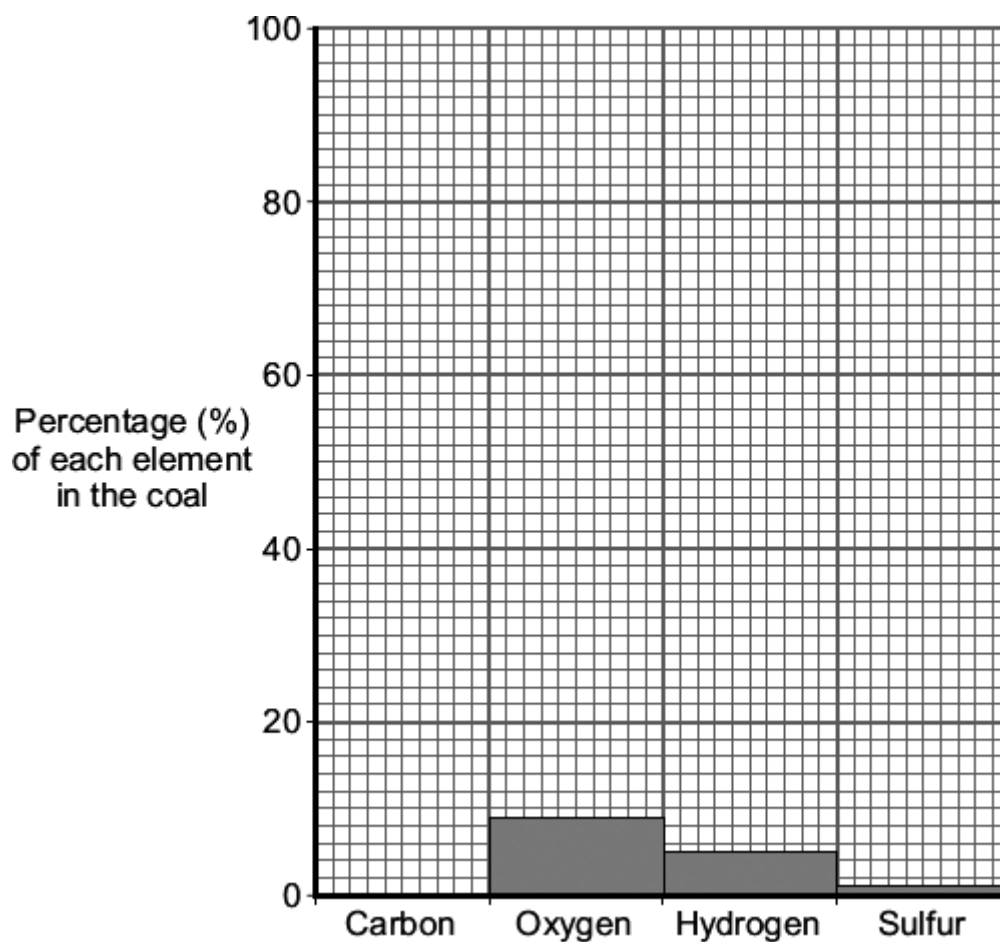
About 3000 million years ago carbon dioxide was one of the main gases in the Earth's early atmosphere.

About 400 million years ago plants and trees grew on most of the land. When the plants and trees died they were covered by sand and slowly decayed to form coal.

Today coal is burned in power stations to release the energy needed by industry.

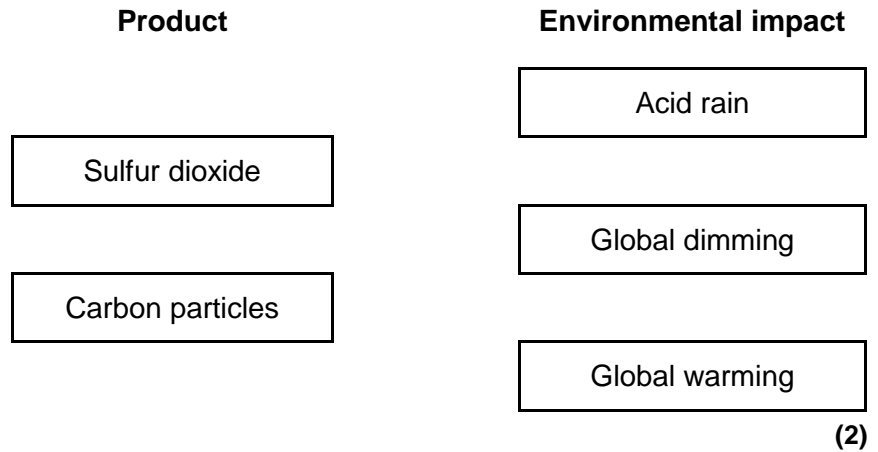


(a) The bar chart shows the percentage of some of the elements in this coal.



- (i) This coal contains 85 % carbon. Draw the bar for carbon on the chart. (1)
- (ii) Coal is burned in the atmosphere to release energy.
Two of the products of burning coal are shown.

Draw **one** line from each product to its environmental impact.



(b) Use the information above and your knowledge and understanding to answer these questions.

- (i) How did the formation of coal decrease the amount of carbon dioxide in the Earth's early atmosphere?

(1)

- (ii) How does burning coal affect the amount of carbon dioxide in the Earth's atmosphere?
Explain your answer.

(2)

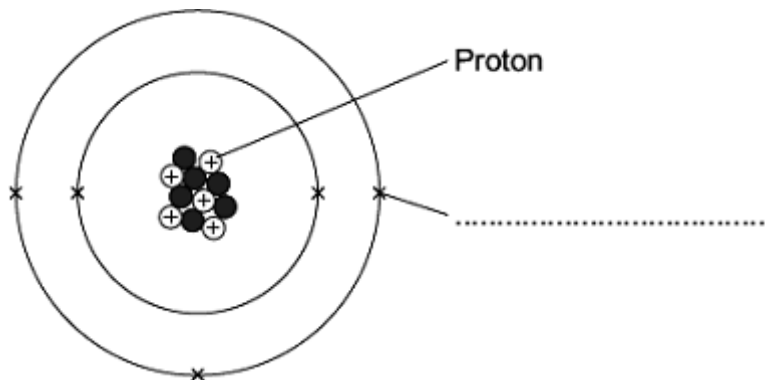
(Total 6 marks)

Q2.

The diagram represents an atom of an element.

- (a) Choose **one** word from the box to complete the label on the diagram.

| | | |
|----------|---------|---------|
| electron | neutron | nucleus |
|----------|---------|---------|



(1)

(b) (i) What is the atomic (proton) number of this atom? _____

(1)

(ii) Name the element.

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

The name of the element is _____ .

(1)

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

5 11 16

(1)

(ii) Another atom of this element has a different mass number.

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

Atoms of the same element with different numbers of

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

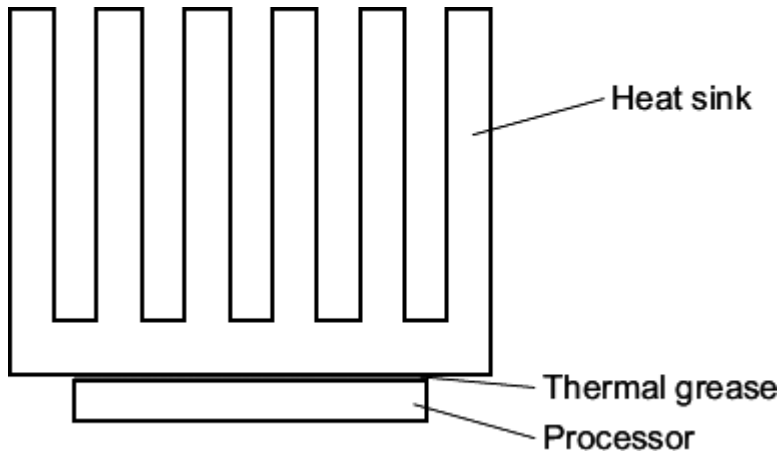
are called isotopes.

(1)

(Total 5 marks)

Q3.

The diagram shows how a heat sink is placed on top of a processor in a computer. The heat sink is a large piece of metal which conducts heat away from the processor. If the processor gets too hot it may be damaged.



(a) (i) Describe the structure of a metal.

(3)

(ii) Why are metals very good conductors of heat?

(1)

(b) When viewed under a microscope, it can be seen that the surfaces of the processor and the heat sink that are in contact are not flat. There are lots of tiny gaps between the two surfaces. The gaps contain air, which does not conduct heat very well. Thermal grease is used to fill the gaps between the processor and the heat sink to improve the transfer of heat from the processor to the heat sink.

One type of thermal grease contains nanosized particles of silver. The manufacturer claims that the nanosized particles help to transfer heat better than normal sized particles.

(i) How are nanosized particles different from normal sized particles?

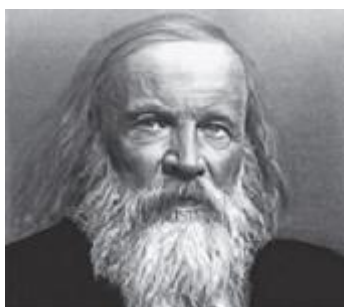
(1)

(ii) Suggest **one** reason why nanosized particles of silver might help to transfer heat better than normal sized particles.

(1)
(Total 6 marks)

Q4.

By 1869, about 60 elements had been discovered.
Mendeleev arranged these elements in a table, in order of their atomic weight.
He put elements with similar chemical properties in the same column.
Mendeleev and part of his table are shown below.



| Column | | | | | | |
|--------|----|----|----|---|---|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| H | | | | | | |
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |

By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

Use the periodic table on the Data Sheet to help you to answer these questions.

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

In the periodic table the columns are known as

groups.

periods.

rows.

(1)

- (b) Suggest **one** reason why hydrogen should **not** have been put in column 1.

(1)

- (c) In 1895, the first of a new family of elements was discovered.
One of the new elements was called helium.

Where has this new family of elements been placed in the modern periodic table?

(1)

- (d) Complete the sentence.

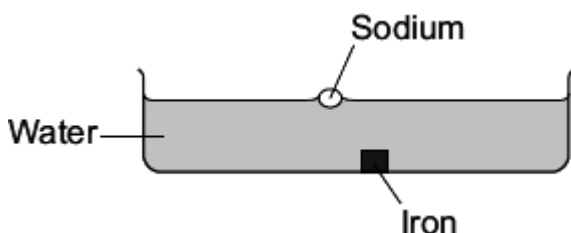
In the periodic table on your Data Sheet, the elements are arranged in order of their atomic _____ .

(1)
(Total 4 marks)

Q5.

How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.



A student observed that:

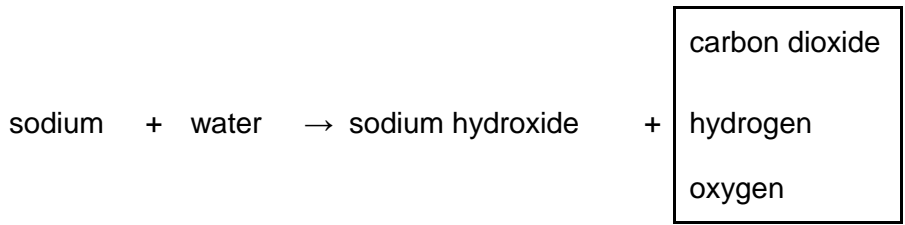
| Sodium | Iron |
|--|---|
| floated on the surface of the water | sank to the bottom of the water |
| melted to form a molten ball of sodium | did not melt |
| reacted to produce a gas | did not react |
| no sodium was left after 5 minutes | the cube of iron remained after 5 minutes |

(a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

| Sodium compared with iron | Tick(✓) |
|-----------------------------------|---------|
| sodium has a higher boiling point | |
| sodium has a lower density | |
| sodium is harder | |
| sodium is more reactive | |
| sodium is softer | |

(2)

(b) Draw a ring around the correct answer to complete the word equation.



(1)

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

Sodium hydroxide is an alkali because it produces H⁺(aq)
OH⁻(aq)
Na⁺(aq) ions

in aqueous solution.

(1)

(Total 4 marks)

Q6.

By 1869, about 60 elements had been discovered. Mendeleev arranged these elements in a table, in order of their atomic weight. He also put elements with similar chemical properties in the same columns.

Mendeleev and part of his table are shown below.



| | Group | | | | | | | |
|----------|---------|----------|--------|---------|---------|----------|----------|----------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Period 1 | H | | | | | | | |
| Period 2 | Li | Be | B | C | N | O | F | |
| Period 3 | Na | Mg | Al | Si | P | S | Cl | |
| Period 4 | K Cu | Ca Zn | - - | Ti - | V As | Cr Se | Mn Br | Fe Co Ni |

(a) (i) Name **one** element in Group 1 of Mendeleev's table that is not in Group 1 of the periodic table on the Data Sheet. Give a reason why this element should not be in Group 1.

Name of element _____

Reason _____

(2)

(ii) Which group of the periodic table on the Data Sheet is missing from Mendeleev's table?

(1)

(b) The gaps (–) in Mendeleev's table were for elements that had not been discovered.

(i) Compare Mendeleev's table with the periodic table on the Data Sheet.

Name **one** of the elements in Period 4 that had not been discovered by 1869.

(1)

(ii) Mendeleev was able to make predictions about the undiscovered elements. This eventually led most scientists to accept his table.

Suggest what predictions Mendeleev was able to make about these undiscovered elements.

(2)

(c) In terms of their electronic structure:

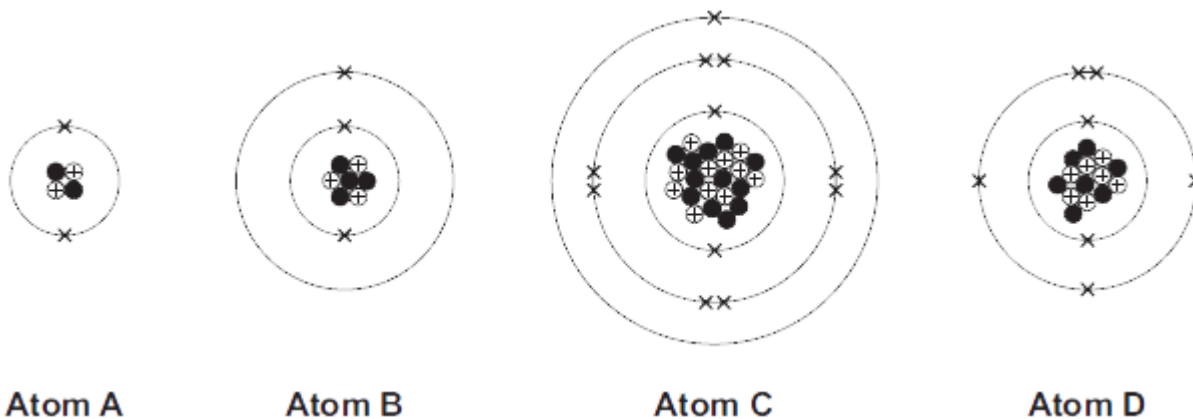
(i) state why lithium and sodium are both in Group 1

(1)

(ii) explain why sodium is more reactive than lithium.

Q7.

The diagrams show the sub-atomic particles in four different atoms.



Use the Chemistry Data Sheet to help you to answer these questions.

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

(i) The centre of each atom is called the

- energy level.
- molecule.
- nucleus.

(1)

(ii) The centre of each atom contains neutrons and

- bonds.
- electrons.
- protons.

(1)

(b) Complete the sentence.

There is no overall electrical charge on each atom because the number of _____ is equal to the number of _____

(1)

(c) What is the name of the element represented by atom **D**? _____

(1)

(d) Which **two** of the atoms, **A**, **B**, **C** and **D**, are in the same group of the periodic table?

Give a reason for your answer.

Atom and atom

Reason _____

(2)

(Total 6 marks)

Q8.

Ethanol (C_2H_5OH) can be made from ethene or from sugar.

- (a) Complete the table which shows the number of atoms of each element in the formula of ethanol.

Use the Chemistry Data Sheet to help you to complete the table.

| Element | Symbol | Number of atoms in the formula C_2H_5OH |
|----------|--------|---|
| Carbon | C | 2 |
| Hydrogen | H | _____ |
| _____ | O | 1 |

(2)

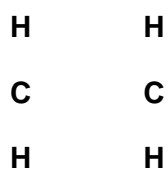
- (b) Ethene (C_2H_4) is produced when hydrocarbons are cracked.

- (i) Tick (✓) **two** conditions needed to crack a hydrocarbon.

| Condition | Tick (✓) |
|--|--------------------------|
| The presence of an emulsifier. | <input type="checkbox"/> |
| Heating the hydrocarbon to a high temperature. | <input type="checkbox"/> |
| Adding oxygen to the hydrocarbon. | <input type="checkbox"/> |
| The presence of a catalyst. | <input type="checkbox"/> |

(2)

- (ii) Draw the missing bonds to complete the displayed structure of ethene.



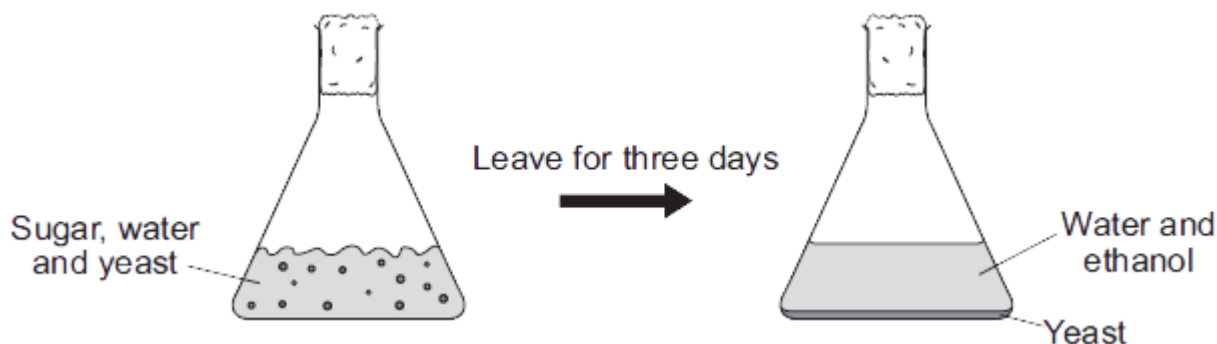
(1)

- (iii) Name the substance added to ethene (C_2H_4) to produce ethanol (C_2H_5OH).

(1)

- (c) The diagram shows how a solution of ethanol is made from sugar dissolved in water.

The boiling point of ethanol is 78°C and the boiling point of water is 100°C .



- (i) Name the gas produced during this reaction.

(1)

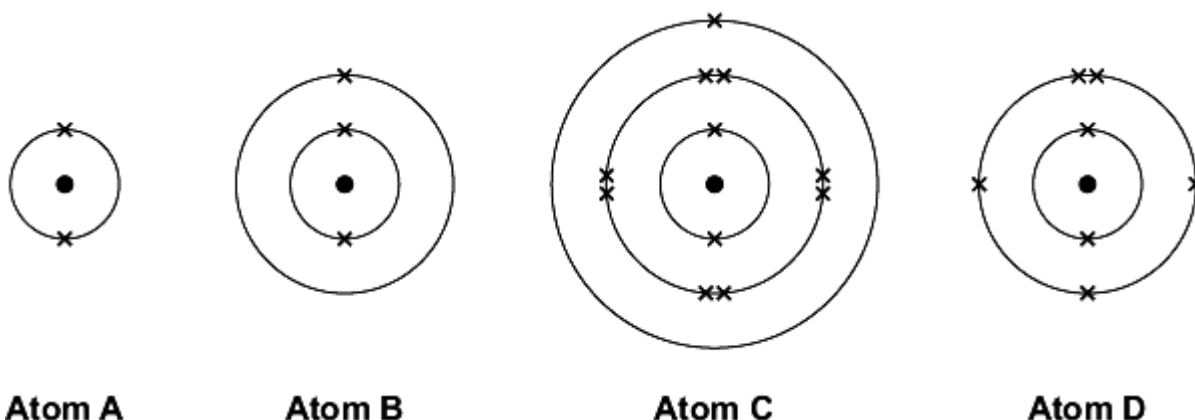
- (ii) What are the main steps needed to obtain pure ethanol from the mixture produced after three days?

(2)

(Total 9 marks)

Q9.

The diagrams show the electronic structure of four different atoms.



Use the Chemistry Data Sheet to help you to answer these questions.

- (a) Name the two sub-atomic particles in the nucleus of an atom.

(1)

(b) Why is there no overall electrical charge on each atom?

(1)

(c) Why is **Atom A** unreactive?

(1)

(d) Which **two** of these atoms have similar chemical properties?
Give a reason for your answer.

(2)

(Total 5 marks)

Q10.

The table shows some properties of gases in dry air

| Gas in dry air | Density in kg/m ³ | Melting point in °C | Boiling point in °C | Percentage (%) in air |
|----------------|------------------------------|---------------------|---------------------|-----------------------|
| Nitrogen | 1.2506 | -210 | -196 | 78.08 |
| Oxygen | 1.4290 | -219 | -183 | 20.95 |
| Carbon dioxide | 1.977 | -57 | -57 | 0.033 |
| Helium | 0.1785 | -272 | -269 | 0.00052 |
| Neon | 0.8999 | -249 | -246 | 0.0019 |
| Argon | 1.7837 | -189 | -186 | 0.934 |
| Krypton | 3.74 | -157 | -153 | 0.00011 |
| Xenon | 5.86 | -112 | -108 | 0.0000087 |

(a) In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

(2)

- (b) Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

Step 1: Filter to remove solid particles

Step 2: Remove carbon dioxide

Step 3: Cool the remaining air to $-200\text{ }^{\circ}\text{C}$

Step 4: Separate by allowing the liquefied gases to warm up.

- (i) Carbon dioxide is removed before the air is cooled to $-200\text{ }^{\circ}\text{C}$.

Suggest **one** reason why.

(1)

- (ii) Which two gases do **not** condense when the remaining air is cooled to $-200\text{ }^{\circ}\text{C}$?

_____ and _____

(1)

- (iii) Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

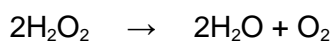
Name these **two** gases and give a reason for your answer.

(2)

(Total 6 marks)

Q11.

- (a) The symbol equation for the decomposition of hydrogen peroxide is:

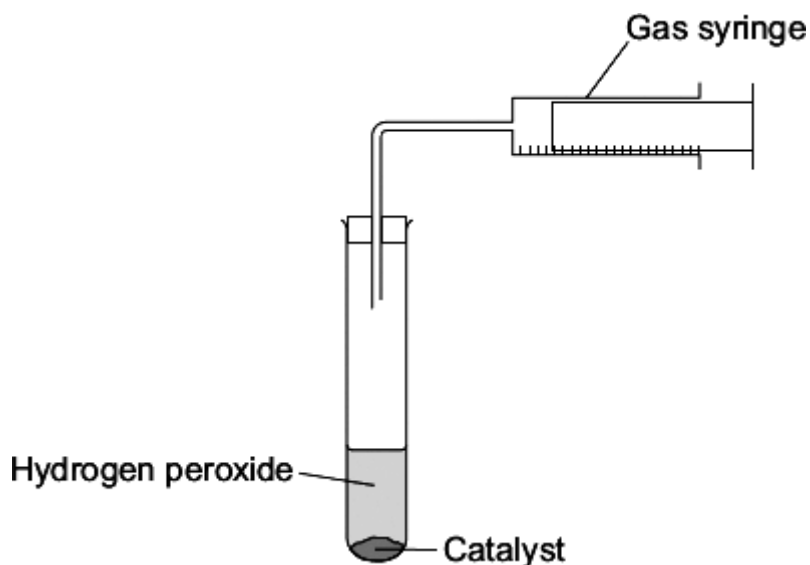


Complete the word equation for the decomposition of hydrogen peroxide.

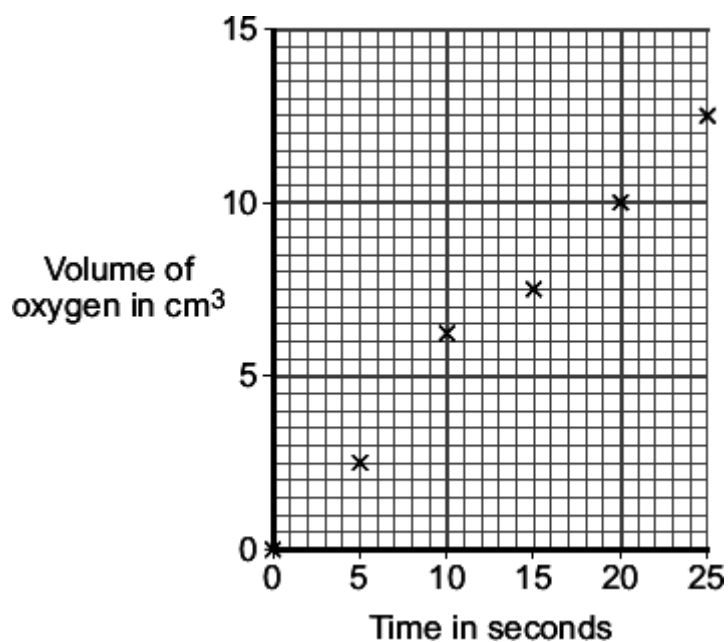


(1)

- (b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



- (i) Draw a straight line of best fit to complete the graph.



(1)

- (ii) Draw a circle around the anomalous point on the graph.

(1)

- (iii) What is the volume of oxygen given off after 15 seconds?

_____ cm³

(1)

- (iv) How did the volume of oxygen change between 0 and 25 seconds?

(1)

(c) The student wanted to make the reaction faster.

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

(i) To make the reaction faster, the temperature should be

higher.
lower.
the same.

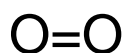
(1)

(ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.
more concentrated.
the same.

(1)

(d) The diagram represents the bonding in oxygen.



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

(i) When two oxygen atoms bond, the atoms

share
transfer
delocalise

electrons.

(1)

(ii) The oxygen atoms are joined by

ionic
metallic
covalent

bonds.

(1)

(iii) Oxygen is made of

simple molecules.
a giant lattice.
macromolecules.

(1)

(e) When hydrogen peroxide decomposes water is produced.

Which **two** statements in the table explain why water is a liquid at room

temperature?

Tick (✓) the **two** statements.

| Statement | Tick (✓) |
|--|----------|
| Water has a boiling point of 100 °C. | |
| Water is made of ions. | |
| Water has a melting point lower than room temperature. | |
| Water has a giant covalent structure. | |

(2)
(Total 12 marks)

Q12.

Gold and gold ions are used as catalysts.

(a) An atom of gold is represented as:



Complete the sentences.

The atomic number of gold is _____

The number of electrons in an atom of gold is _____

(2)

(b) Scientists have found that gold nanoparticles are very good catalysts.

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

A gold nanoparticle contains a few

| |
|----------|
| hundred |
| thousand |
| million |

 atoms.

(1)

(c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.



(i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called _____

(1)

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

The number of these particles lost when a gold atom becomes a gold ion is

one.

two.

three.

(1)

- (d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

(1)

- (e) Chloroethene can react to make a thermosoftening polymer.

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

When heated, a thermosoftening polymer will

dissolve.

melt.

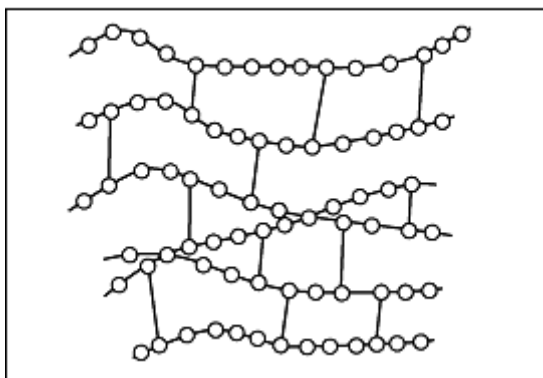
solidify.

(1)

- (ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

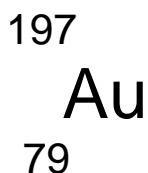
(1)

(Total 8 marks)

Q13.

This question is about gold (Au).

- (a) An atom of gold is represented as:



How many neutrons are in this atom of gold? _____

(1)

- (b) Gold ions are used as a catalyst.

How does a gold atom (Au) become a gold ion (Au³⁺)?

(2)

- (c) A gold catalyst can be used when carbon monoxide reacts with oxygen to make carbon dioxide.

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



(2)

- (ii) Carbon dioxide has a very low boiling point.

Explain why.

(3)

- (d) Gold is used as a catalyst in industrial processes. Gold is rare and increasingly expensive.

Suggest **three** reasons why gold is still used in industrial processes.

(3)
(Total 11 marks)

Q14.

This question is about calcium hydroxide.

Ancient artworks and monuments can be protected from acid rain if the surface is sprayed with calcium hydroxide nanoparticles.



By Svilen Enev (Own work) [GFDL or CC-BY-SA-3.0], via Wikimedia Commons

- (a) Calcium hydroxide has the formula $\text{Ca}(\text{OH})_2$

Why are there two hydroxide ions for each calcium ion in the formula?

(1)

- (b) The calcium hydroxide is used in the form of *nanoparticles*.

What are *nanoparticles*?

(1)

(c) A student added water to calcium oxide to make calcium hydroxide.

The equation for the reaction is shown below.



Calculate the maximum mass of calcium hydroxide which could be made from 2.00 g of calcium oxide.

Relative atomic masses (A_r): H = 1; O = 16; Ca = 40.

Maximum mass of calcium hydroxide = _____ g

(3)

(Total 5 marks)

Q15.

Iron is extracted from its ore.

(a) Iron ore is quarried.



Photograph supplied by Stockbyte/Thinkstock

Quarrying iron ore has impacts that cause environmental problems.

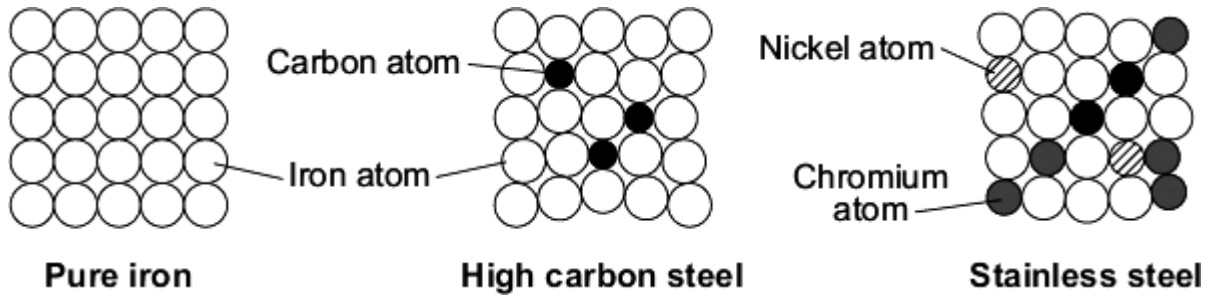
Tick (✓) **two** impacts of quarrying that cause environmental problems.

| | |
|---------------------|----------|
| Impact of quarrying | Tick (✓) |
|---------------------|----------|

| | |
|-----------------------|--|
| puts off tourists | |
| causes dust pollution | |
| increases jobs | |
| increases traffic | |

(2)

(b) The diagrams represent the atoms in iron and the atoms in two alloys of iron.



Use the diagrams to help you to answer these questions.

(i) Complete the sentence.

Pure iron does **not** have many uses because _____

_____ (1)

(ii) Stainless steel is more expensive than pure iron.

Suggest why.

 _____ (1)

(c) Draw a ring around the correct answer to complete each sentence.

(i) Pure iron is

- a compound.
- an element.
- a mixture.

(1)

(ii) High carbon steel is used for a drill bit because it is

- brittle.
- easily bent.
- hard.

(1)

(iii) Stainless steel is used to make cutlery because it

contains three different atoms.

melts at a very high temperature.

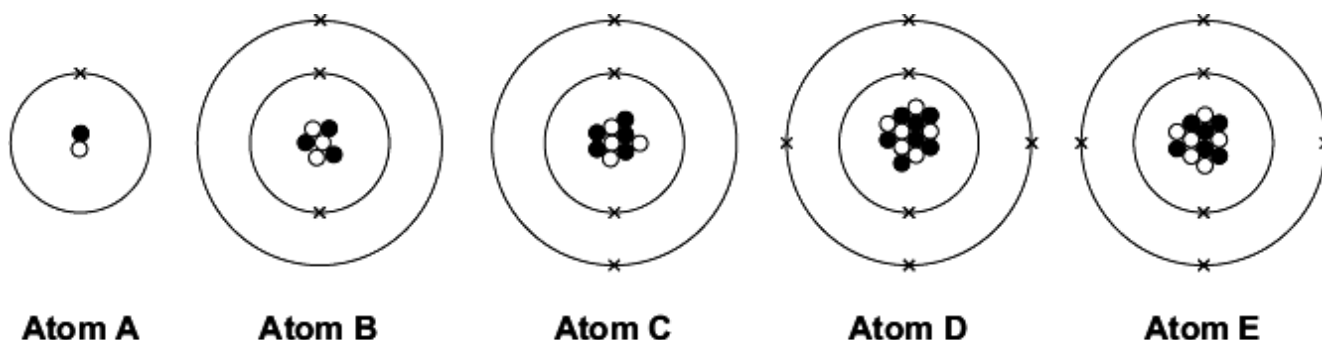
is resistant to corrosion.

(1)

(Total 7 marks)

Q16.

The diagrams show five different atoms, **A**, **B**, **C**, **D** and **E**.



Key

- represents a proton
- represents a neutron
- × represents an electron

(a) Which atom, **A**, **B**, **C**, **D** or **E**:

(i) has an atomic number (proton number) of 3

Atom

(1)

(ii) has a mass number of 2

Atom

(1)

(iii) is in Group 2 of the periodic table?

Atom

(1)

(b) Which **two** atoms from **A**, **B**, **C**, **D** and **E** are isotopes of the same element?

Atom and Atom

(1)

(c) Which particle in an atom has a negative charge? _____

(1)

(Total 5 marks)

Q17.

Stage smoke is used for special effects at pop concerts.



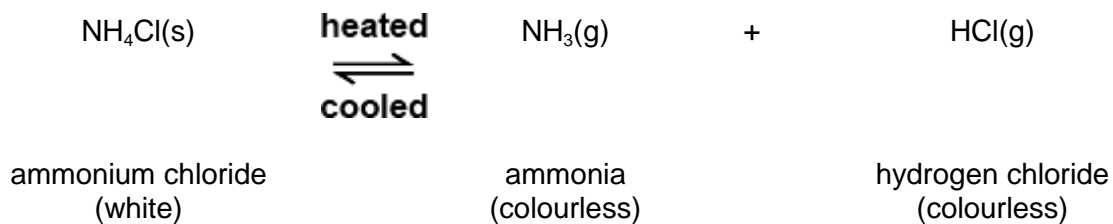
By Sam Cockman [CC BY 2.0], via Flickr

Ammonium chloride can be used to make stage smoke.

Ammonium chloride is a white solid.

When heated, ammonium chloride produces white smoke which can be blown onto the stage.

The equation shows what happens when ammonium chloride is heated and cooled.



(a) The sentences explain how the smoke is made.

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

Use the information and the equation to help you.

When heated, ammonium chloride makes two colourless

solids.

liquids.

gases.

These are blown into the air where they cool and make a

| |
|------------|
| colourless |
| black |
| white |

| |
|---------|
| solid. |
| liquid. |
| gas. |

which is

| |
|--------------------|
| ammonia. |
| ammonium chloride. |
| hydrogen chloride. |

(4)

(b) Complete the sentence.

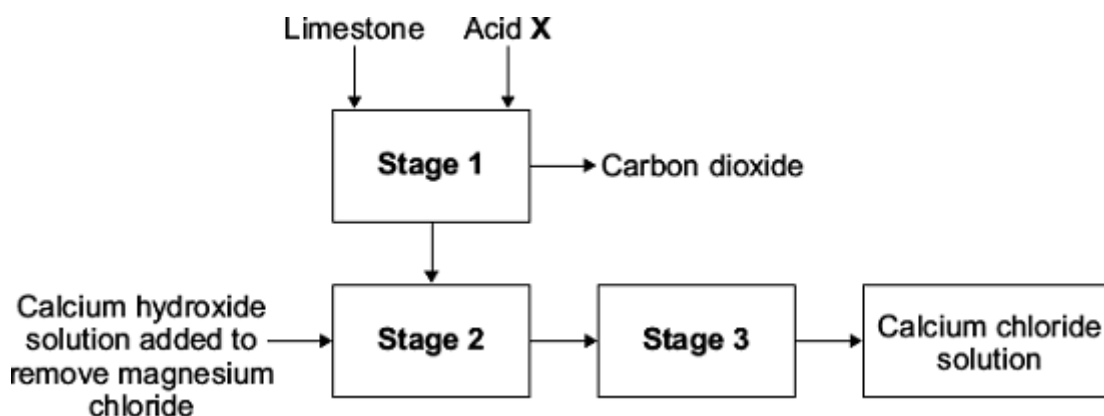
The symbol \rightleftharpoons means that the reaction is _____

(1)

(Total 5 marks)

Q18.

(a) Calcium chloride is made from limestone. Limestone contains mainly calcium carbonate and a small amount of magnesium carbonate.



(i) In **stage 1** calcium carbonate reacts with acid **X** to form calcium chloride.

Draw a ring around the name of acid **X**.

hydrochloric

nitric

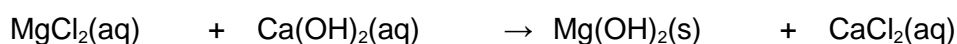
sulfuric

(1)

(ii) **Stage 1** produces a concentrated solution of calcium chloride. The solution also contains magnesium chloride.

Calcium hydroxide solution is added in **stage 2** to remove the magnesium chloride.

The equation for this reaction is:



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

In **stage 2** a precipitate is made because

magnesium hydroxide is

dissolved

insoluble

soluble

in water.

In **stage 3** the solid magnesium hydroxide can be separated from the calcium

chloride solution using

chromatography.

electrolysis.

filtration.

(2)

- (iii) What method can be used to change the calcium chloride solution into solid calcium chloride?

Draw a ring around your answer.

crystallisation

electrolysis

reduction

(1)

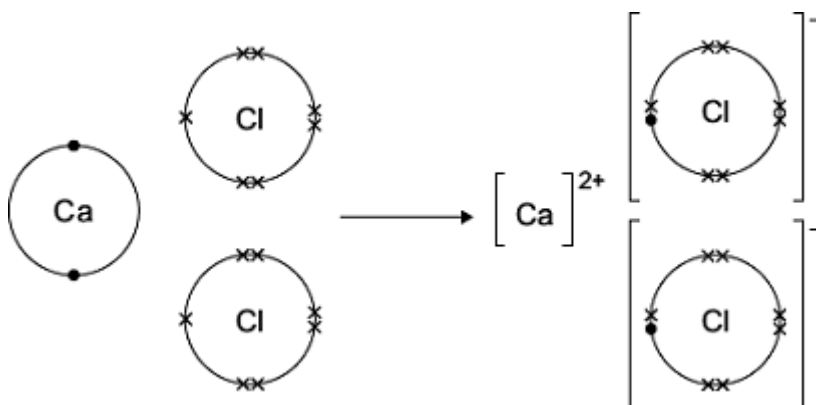
- (b) Calcium chloride can also be made by reacting calcium with chlorine:



The diagram shows what happens to atoms of calcium and chlorine in this reaction.

The dots (•) and crosses (x) are used to represent electrons.

Only the outer electrons are shown.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when calcium reacts with chlorine to make calcium chloride.

(4)
(Total 8 marks)

Q19.

Platinum and gold can both be used to make wedding rings.



By Jeff Belmonte from Cuiabá, Brazil (Flickr) [CC-BY-2.0], via Wikimedia Commons

Use the Data Sheet to help you to answer these questions.

- (a) Draw a ring around the part of the periodic table in the list below to which platinum and gold belong.

group 1 group 2 transition elements group 7

(1)

- (b) Platinum and gold have properties that make them suitable for wedding rings.

Tick (✓) **two** of these properties.

| Property | Tick (✓) |
|---------------------------------------|----------|
| These metals do not react with air. | |
| These metals have low melting points. | |
| These metals do not react with water. | |

| | |
|----------------------------------|--|
| | |
| These metals have low densities. | |

(2)
(Total 3 marks)

Q20.

John Newlands was a chemist who worked in a sugar factory.

In 1866 he designed a periodic table.

He arranged the elements in order of their relative atomic masses.

He found a repeating pattern for some of the elements.

Newlands wrote, 'the eighth element starting from a given one, is a kind of repetition of the first, like the eighth note in an octave of music'.

| | | | | | | |
|--------|----|-------|--------|----|--------|--------|
| H | Li | G | Bo | C | N | O |
| F | Na | Mg | Al | Si | P | S |
| Cl | K | Ca | Cr | Ti | Mn | Fe |
| Co, Ni | Cu | Zn | Y | In | As | Se |
| Br | Rb | Sr | Ce, La | Zr | Di, Mo | Ro, Ru |
| Pd | Ag | Cd | U | Sn | Sb | Te |
| I | Cs | Ba, V | Ta | W | Nb | Au |
| Pt, Ir | Tl | Pb | Th | Hg | Bi | Os |

Newlands' periodic table

- (a) In Newlands' periodic table, the elements lithium, sodium and potassium are grouped together.

Give **two** properties of these elements which support the idea that they should be grouped together.

1. _____

2. _____

(2)

- (b) Newlands' periodic table was not accepted by most chemists in 1866.

Suggest reasons why.

Use the Newlands' periodic table above to help you to answer this question.

(3)

(c) State **and** explain **one** way in which Mendeleev improved Newlands' periodic table.

(2)

(Total 7 marks)

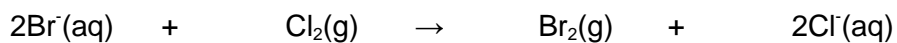
Q21.

The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

(1)

(b) Sea water contains bromide ions (Br⁻).
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.
Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.



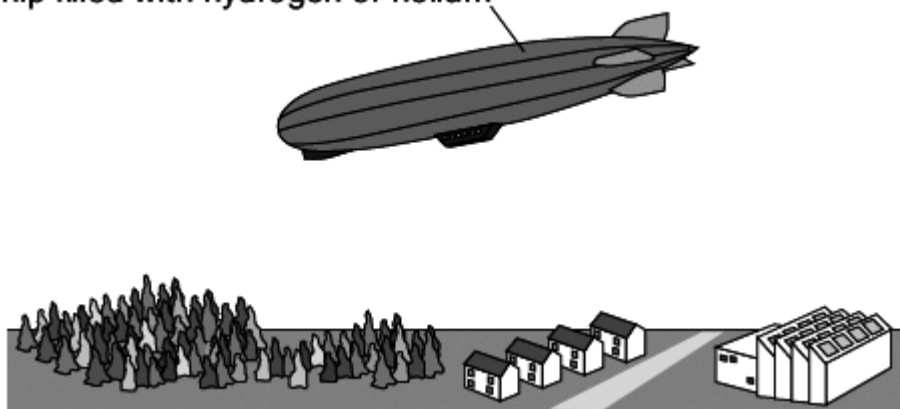
Explain, in terms of electrons, why chlorine is more reactive than bromine.

(3)
(Total 4 marks)

Q22.

Hydrogen and helium have both been used in airships.

Airship filled with hydrogen or helium



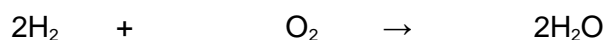
- (a) Tick (✓) the property which both hydrogen and helium have that makes an airship float in air.

| Property | Tick (✓) |
|---------------------|----------|
| Colourless | |
| Less dense than air | |
| More dense than air | |

(1)

- (b) (i) Hydrogen is no longer used in airships because it burns in oxygen.

The chemical equation for this reaction is shown.



Complete the word equation for this reaction



(1)

- (ii) Helium is safer than hydrogen because it does **not** burn in oxygen.

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

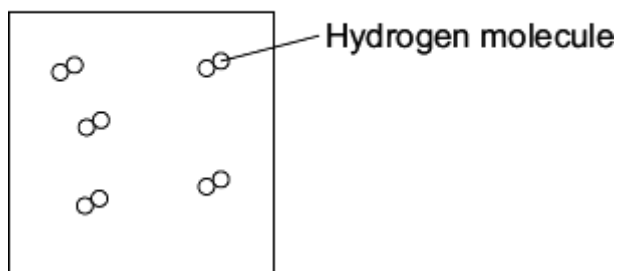
Helium is now used in airships because it is

a fuel.
already in the air.
unreactive.

(1)

(c) **Diagram 1** represents hydrogen molecules.

Diagram 1



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

Each hydrogen molecule is made up of two hydrogen

atoms.
compounds.
elements.

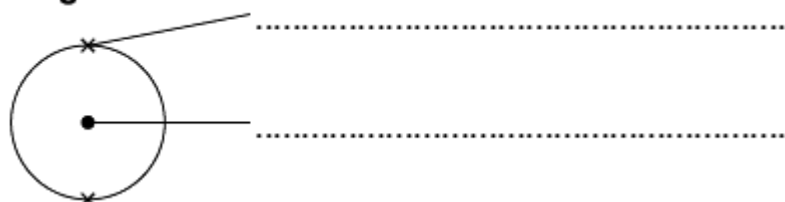
(1)

(d) **Diagram 2** shows the parts of a helium atom.

Use words from the box to label **diagram 2**.

bond electron nucleus

Diagram 2



(2)

(Total 6 marks)

Q23.

Titanium is used for replacement hip joints because it has a low density, is strong and does not corrode.

Titanium is extracted from titanium dioxide (TiO_2) in three stages.

(a) **Stage 1**

Titanium dioxide is converted into titanium chloride (TiCl₄) because the metal cannot be extracted from its oxide by *reduction* with carbon.

- (i) What does *reduction* mean?

(1)

- (ii) Balance the chemical equation for the conversion of titanium dioxide to titanium chloride.



(1)

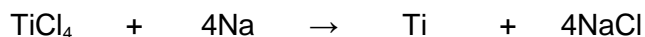
- (iii) Chemical equations are always balanced. Explain why.

(1)

- (b) **Stage 2**

Titanium is extracted from the titanium chloride by reacting it with sodium at 1000 °C in a reactor.

The only other substance in the reactor is argon gas.



- (i) What does this tell you about the reactivity of sodium compared with titanium?

(1)

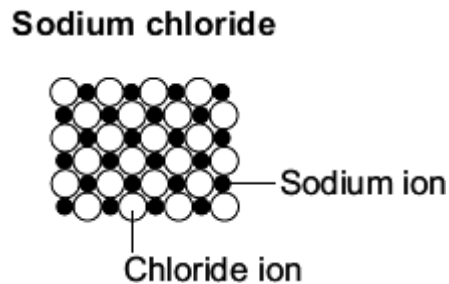
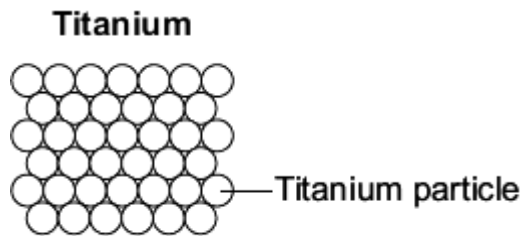
- (ii) Suggest why the reactor contains argon and **not** air.

(1)

- (c) **Stage 3**

After **Stage 2** the titanium is separated from the products by washing out the sodium chloride with water.

The diagrams show sections through the lattice of titanium metal and the lattice of sodium chloride.



How do the diagrams show that:

- (i) titanium is an element

(1)

- (ii) sodium chloride is a compound?

(2)

(Total 8 marks)

Q24.

- (a) A magnesium atom contains 12 protons (●), 12 neutrons (○) and 12 electrons (x).

Which diagram, **A**, **B** or **C**, represents this magnesium atom?

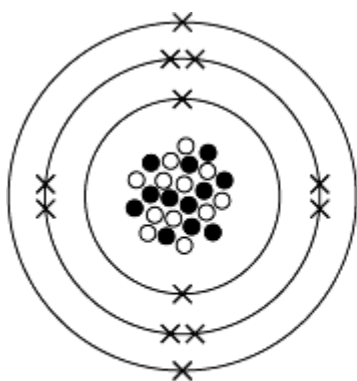


Diagram A

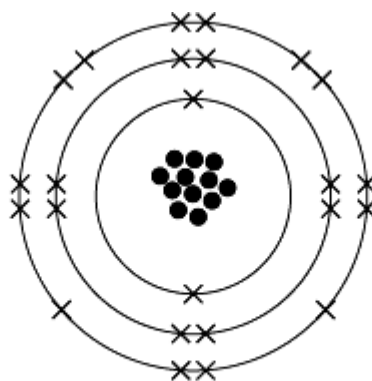


Diagram B

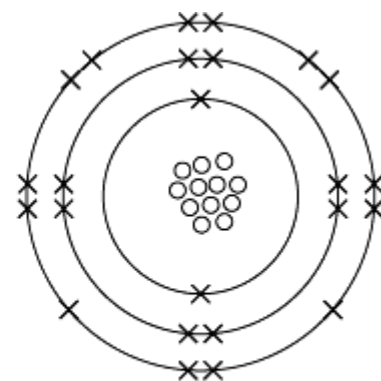
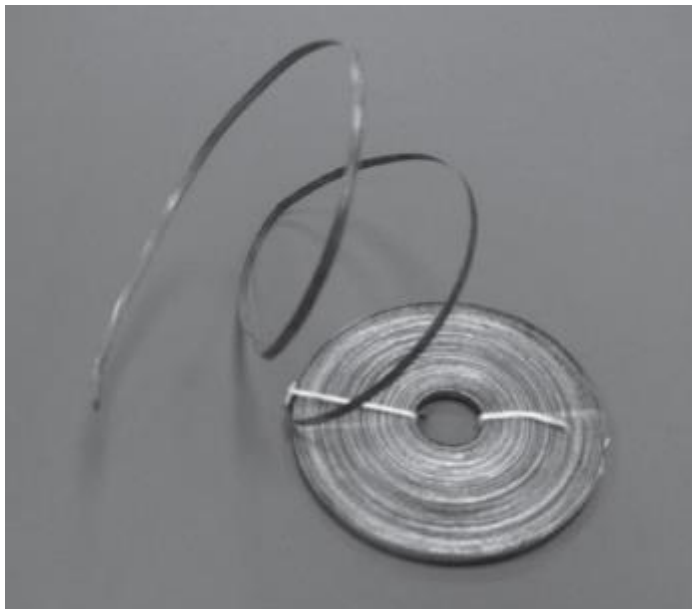


Diagram C

This magnesium atom is **Diagram**

(1)

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



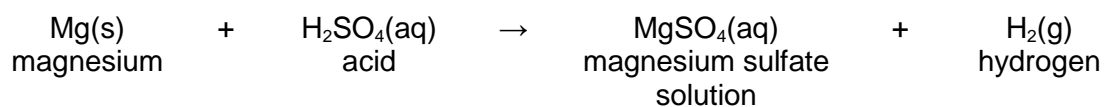
Tick (✓) **two** reasons which explain why metals can be shaped.

| Reason why | Tick (✓) |
|---|----------|
| The atoms are all joined by covalent bonds. | |
| The atoms can slide over each other. | |
| The atoms are large. | |
| The atoms are in layers. | |

(2)

(c) 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) Draw a ring around the name of the acid used in this reaction.

hydrochloric

nitric

sulfuric

(1)

(ii) Use the equation to help you to answer this question.

Tick (✓) **two** things that happen when this reaction takes place.

| | Tick (✓) |
|-----------------------|----------|
| Bubbles are produced. | |

| | |
|---------------------------|--|
| The magnesium disappears. | |
| A solid is formed. | |
| Water is formed. | |

(2)

- (iii) Draw a ring around a method to get solid magnesium sulfate from magnesium sulfate solution.

crystallisation

electrolysis

oxidation

(1)

(Total 7 marks)

Q25.

Calamine lotion is used to treat itching. The main ingredients are two metal oxides.



- (a) One of the metal oxides has a relative formula mass (M_r) of 81.

The formula of this metal oxide is MO.
(M is **not** the correct symbol for the metal.)

The relative atomic mass (A_r) of oxygen is 16.

- (i) Calculate the relative atomic mass (A_r) of metal M.

Relative atomic mass (A_r) = _____

(2)

- (ii) Use your answer to part (a)(i) and the periodic table on the Data Sheet to name metal M.

The name of metal M is _____ .

(1)

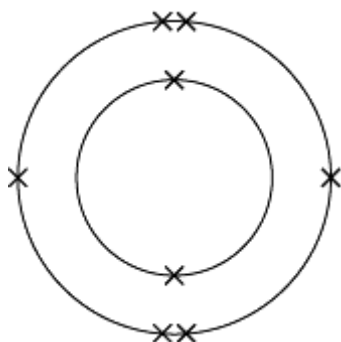
(b) The other metal oxide is iron(III) oxide.

This contains iron(III) ions (Fe^{3+}) and oxide ions (O^{2-}).

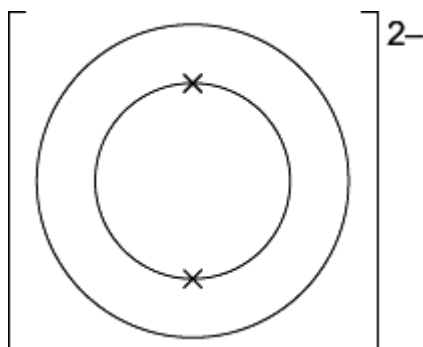
(i) Explain in terms of electrons how an iron atom (Fe) can change into an iron(III) ion (Fe^{3+}).

(2)

(ii) The diagram below represents the electronic structure of an oxygen atom (O).



Complete the diagram below to show the electronic structure of an oxide ion (O^{2-}).

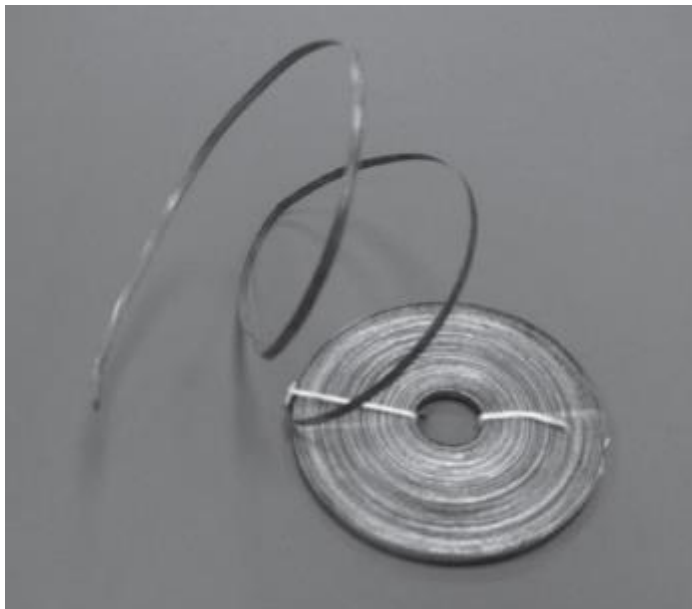


(1)

(Total 6 marks)

Q26.

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

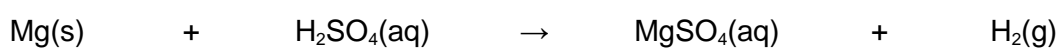


Explain why metals can be shaped.

(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)

Q27.

The periodic table on the Data Sheet may help you to answer these questions.

(a) Part of the periodic table is shown below.

The letters are **not** the symbols of the elements.

Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A, B, C, D, E** or **F**, represents

(i) aluminium

(1)

(ii) a Group 5 element

(1)

(iii) an alkali metal

(1)

(iv) the element with atomic (proton) number of 47

(1)

(v) an element with seven electrons in its outer shell?

(1)

(b) The table shows the boiling points of the Group 7 elements.

The elements are arranged **in alphabetical order**.

| Group 7 element | | |
|-----------------|--------|---------------------|
| Name | Symbol | Boiling point in °C |
| Astatine | At | 337 |
| Bromine | | 58 |
| Chlorine | Cl | -34 |
| Fluorine | F | -188 |
| Iodine | I | 184 |

(i) The symbol for bromine is missing from the table.

What is the symbol for bromine? Symbol = _____

(1)

(ii) Arrange these elements in order of **decreasing** boiling point. The first one and the last one have been done for you.

At _____ F

Highest boiling point \longrightarrow Lowest boiling point

(1)

(c) The table shows some statements about Group 7 elements.

Tick (✓) the **two** correct statements.

| | Tick (✓) |
|--------------------|----------|
| They are halogens. | |

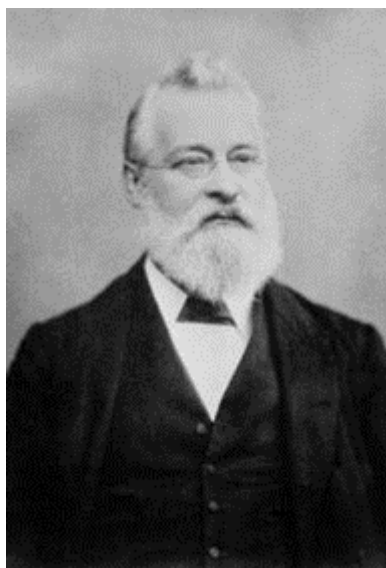
| | |
|---|--|
| They are metals. | |
| They become less reactive down Group 7. | |
| They are compounds. | |

(2)
(Total 9 marks)

Q28.

The periodic table on the Data Sheet may help you answer these questions.

- (a) Many chemists have contributed to the development of the periodic table.



John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866 he suggested that there was a repeating pattern of elements with similar properties every eighth element. Part of Newlands' periodic table is shown below.

| | | | | | | |
|--------|----|----|--------|----|--------|--------|
| H | Li | Be | B | C | N | O |
| F | Na | Mg | Al | Si | P | S |
| Cl | K | Ca | Cr | Ti | Mn | Fe |
| Co, Ni | Cu | Zn | Y | In | As | Se |
| Br | Rb | Sr | Ce, La | Zr | Di, Mo | Ro, Ru |

Many chemists in 1866 did not accept Newland's; periodic table.

By Conget at nl.wikipedia [Public domain], from Wikimedia Commons

- (i) Give **one** piece of evidence which supports Newlands' ideas.

(1)

(ii) Suggest **two** reasons why many chemists in 1866 did not accept Newlands' ideas.

1. _____

2. _____

(2)

(b) Chlorine, bromine and iodine are Group 7 elements.

A student investigated the reactivity of these elements.

The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown below.

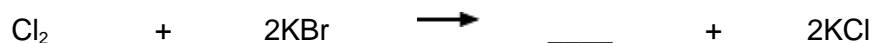
| Solution | Potassium chloride | Potassium bromide | Potassium iodide |
|-----------------|---------------------------|------------------------------|-------------------------|
| Chlorine | | Solution turned orange-brown | Solution turned brown |
| Bromine | No reaction | | Solution turned brown |
| Iodine | No reaction | No reaction | |

(i) Use these results to state **and** explain the trend in reactivity of these Group 7 elements.

(2)

(ii) Complete the equation below, which represents the reaction between chlorine

and potassium bromide.



(1)

- (iii) In terms of electronic structure, state why chlorine, bromine and iodine are in Group 7.

(1)

- (c) Lithium, sodium and potassium are Group 1 elements.

Group 1 elements become **more** reactive down the group.

Explain why in terms of electronic structure.

(3)

(Total 10 marks)

Q29.

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 russelljsmith [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.

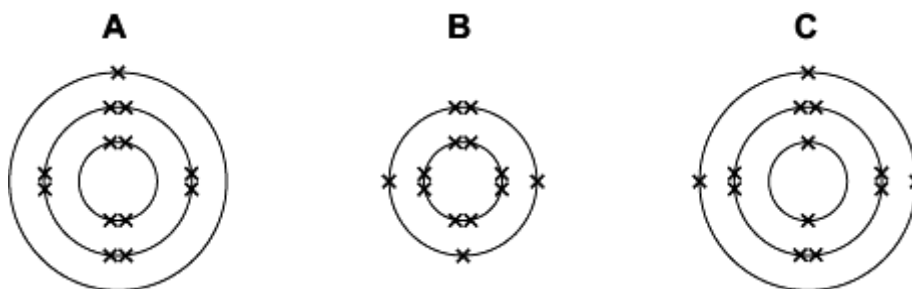
Complete the word equation for this reaction.

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+})

gains

it

loses

three electrons.

shares

(1)

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

gains

it

loses

shares

one

two

three

electrons.

(2)

(Total 8 marks)

Q30.

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)

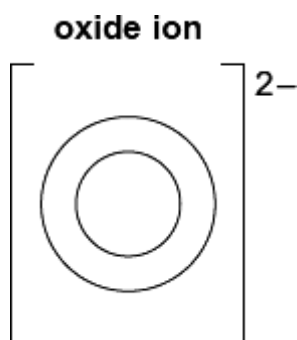
- (c) The white smoke produced is aluminium oxide.

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)

Q31.

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.

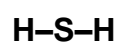
You **must** show all your working to gain full marks.

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

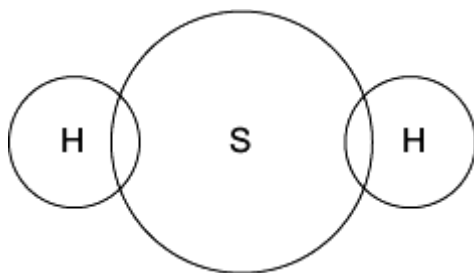
(4)

- (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)

Q32.

Use the periodic table on the Data Sheet to help you to answer these questions.

- (a) The following is a list of symbols of some elements.

| | | | | |
|-----------|-----------|-----------|-----------|-----------|
| Sb | Se | Si | Sn | Sr |
|-----------|-----------|-----------|-----------|-----------|

Choose your answers **only** from the symbols shown in the box above.

Which symbol represents

- (i) a Group 5 element

(1)

(ii) the element in the same group as oxygen (O)

(1)

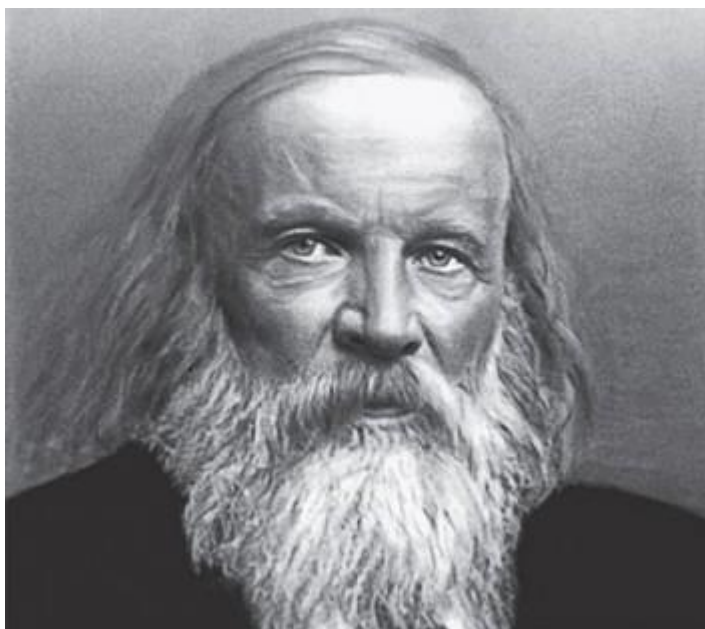
(iii) the element with atomic (proton) number of 50

(1)

(iv) silicon?

(1)

(b)



Mendeleev suggested his version of the periodic table in 1869.

Part of Mendeleev's table is shown below.

| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
|---------|---------|---------|---------|---------|---------|---------|
| H | | | | | | |
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |

| | | | | | | |
|----|----|---|----|----|----|----|
| K | Ca | # | Ti | V | Cr | Mn |
| Cu | Zn | # | # | As | Se | Br |

By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

There are differences between Mendeleev's table and the periodic table on the Data Sheet.

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

(i) Mendeleev left gaps (shown by #) in his table.

Mendeleev left gaps for

| |
|-----------|
| compounds |
| elements |
| mixtures |

 that had not been discovered.

(1)

(ii) Mendeleev put copper (Cu) in the same box as

| |
|----------------|
| bromine (Br). |
| chromium (Cr). |
| potassium (K). |

(1)

(iii) Mendeleev did **not** have a Group

| |
|----|
| 0. |
| 3. |
| 5. |

(1)

(Total 7 marks)

Q33.

Read the information about protecting the bottoms of ships.

| |
|-------------------------------------|
| A Copper-bottomed Investment |
|-------------------------------------|



From the 16th to the 19th century, the bottoms of many wooden ships were protected from marine organisms by being covered with sheets of metal.

At first lead was used on the bottoms of ships, then copper was used until 1832 when Muntz Metal replaced it. Muntz Metal is an alloy of two transition metals, copper and zinc.

Table of data

| | Lead | Copper | Muntz Metal |
|---|-------------|---------------|--------------------|
| Cost (£/kg) | £1.20 | £3.20 | £2.30 |
| Melting point (°C) | 327 | 1083 | 904 |
| Stops sea worms attacking wood | Yes | Yes | Yes |
| Stops barnacles and seaweed sticking to the bottom of the ship | No | Yes | Yes |

(a) Use the information to answer the following questions.

(i) Suggest why copper replaced lead.

(1)

(ii) Suggest why Muntz Metal replaced copper.

(1)

(b) A sample of Muntz Metal contains a very small amount of iron as an impurity.

(i) Name an instrumental method of analysis that could be used to detect iron.

(1)

(ii) Suggest why an instrumental method would detect the iron in this sample of Muntz Metal but a chemical method is **not** likely to be successful.

(1)

(c) Today, ships are made from steel. Steels are alloys of iron, a transition metal.

Give **two** properties of transition metals that make them suitable for making ships.

Property 1 _____

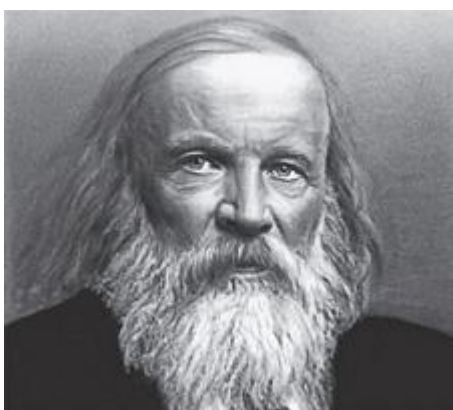
Property 2 _____

(2)

(Total 6 marks)

Q34.

Use the periodic table on the Data Sheet and the information below to help you answer these questions.



Mendeleev was one of the first chemists who classified elements in a systematic way based on atomic weight. He suggested his version of the periodic table in 1869.

He put the elements in order of their atomic weights but reversed the order for some pairs of elements. Then he arranged them in a table so that chemically similar elements were in columns known as Groups. He also left gaps and made predictions.

Part of Mendeleev's table is shown below.

| | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
|---------|---------|---------|---------|---------|---------|---------|

| | | | | | | |
|----|----|----|----|----|----|----|
| H | | | | | | |
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |
| K | Ca | # | Ti | V | Cr | Mn |
| Cu | Zn | # | # | As | Se | Br |
| Rb | Sr | Y | Zr | Nb | Mo | # |
| Ag | Cd | In | Sn | Sb | Te | I |

The gaps Mendeleev left are shown by #.

By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

- (a) Which group of elements in the modern periodic table is missing from Mendeleev's table?

(1)

- (b) Mendeleev reversed the order for some pairs of elements. For example, he put tellurium (Te, atomic weight 128) before iodine (I, atomic weight 127), as shown in his table.

Why did he do this?

(1)

- (c) In 1869 many chemists did **not** agree with Mendeleev's periodic table.

Suggest **three** reasons why.

(3)

(d) In the 20th century, the arrangement of elements in the periodic table was explained in terms of atomic structure.

Describe the links between atomic structure and the periodic table.

(2)

(Total 7 marks)

Q35.

Natural gas is mainly a hydrocarbon called methane.

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

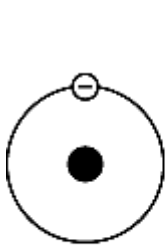
| | | |
|------------------|-----------------|------------------|
| compounds | elements | molecules |
|------------------|-----------------|------------------|

Hydrocarbons contain hydrogen and carbon only.

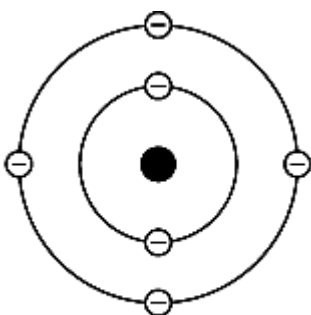
Hydrogen and carbon are _____.

(1)

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



Hydrogen



Carbon

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

| |
|-------|
| bond. |
|-------|

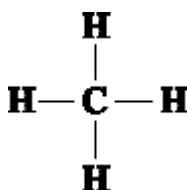
(i) The centre of each atom is called the nucleus.
symbol.

(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)

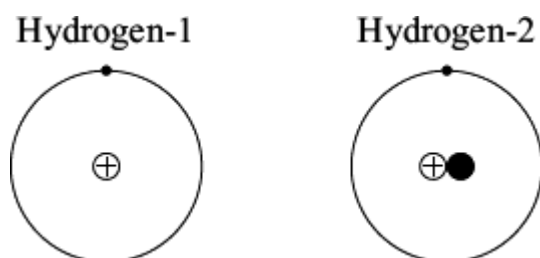
(ii) Hydrogen (H₂) can be used as a fuel.

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

Q36.

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.



(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

_____.

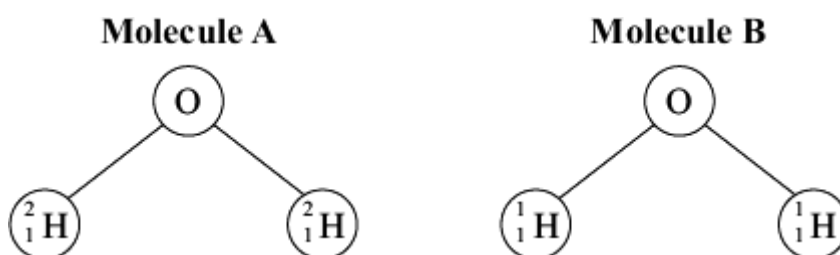
(1)

(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 |

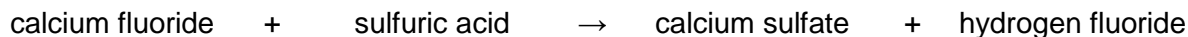
 molecule **B**.

Explain your answer.

Q37.

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

| |
|--------|
| higher |
| lower |

 so that the particles have

| |
|------|
| less |
| more |

 energy

the solid calcium fluoride should be

| |
|--------|
| powder |
| lumps |

 to give a

| |
|-------|
| small |
| big |

 surface area

the sulfuric acid solution should be

| |
|--------------|
| dilute |
| concentrated |

 to give

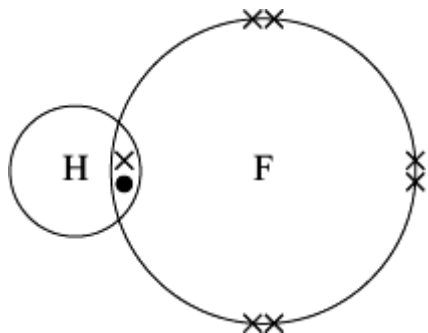
| |
|------|
| less |
| more |

 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)

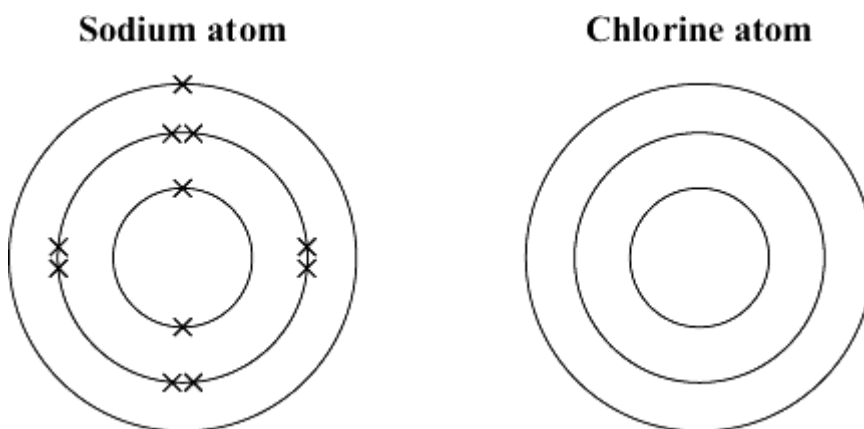
(Total 6 marks)

Q38.

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.



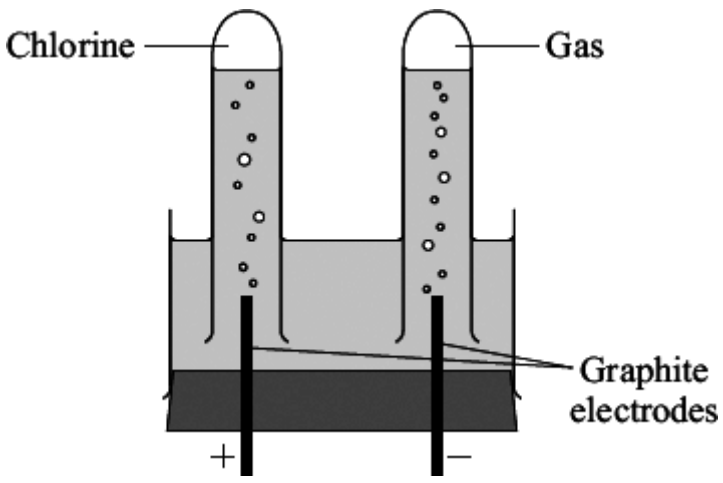
(1)

- (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?

(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)

Q39.

- (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: H = 1; 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.

(2)

(Total 6 marks)

Q40.

- (a) The periodic table on the Data Sheet may help you to answer these questions.

Part of the periodic table is shown below.

| | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

The letters are **not** the symbols of these elements.

Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A**, **B**, **C**, **D** or **E**, represents:

(i) an alkali metal Letter

(1)

(ii) the element calcium Letter

(1)

(iii) a transition element Letter

(1)

(iv) a Group 4 element? Letter

(1)

(b) A chemistry teacher demonstrated the reaction between sodium and water to some students. One of the students wrote the following notes.

The reaction between sodium and water

A piece of sodium was cut easily into smaller pieces with a knife.

The sodium was added to water in a trough.

The sodium:

- floated
- melted quickly to give a silvery ball
- moved on the surface of the water
- fizzed.

Use the information in the box to help you to answer these questions.

What evidence is there that:

(i) sodium has a low melting point

(1)

(ii) sodium is soft

(1)

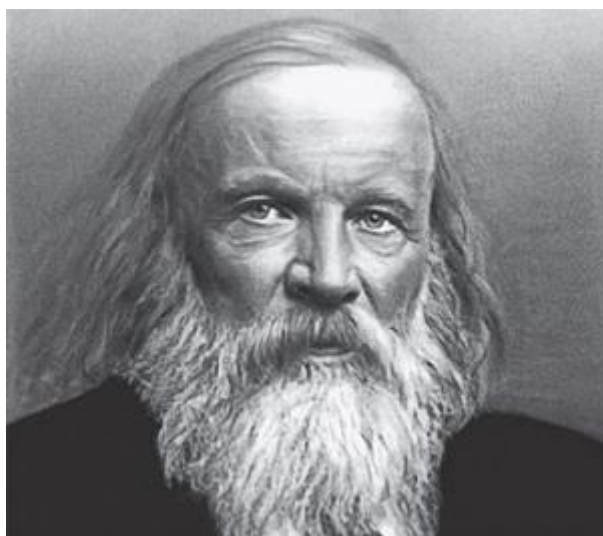
(iii) a gas was produced?

(1)

(Total 7 marks)

Q41.

- (a) Dimitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.



By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

How did Mendeleev know that there must be undiscovered elements and how did he take this into account when he designed his periodic table?

(2)

- (b) By the early 20th century protons and electrons had been discovered.

Describe how this discovery allowed chemists to place elements in their correct order and correct group.

(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why in terms of electronic structure.

(2)

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

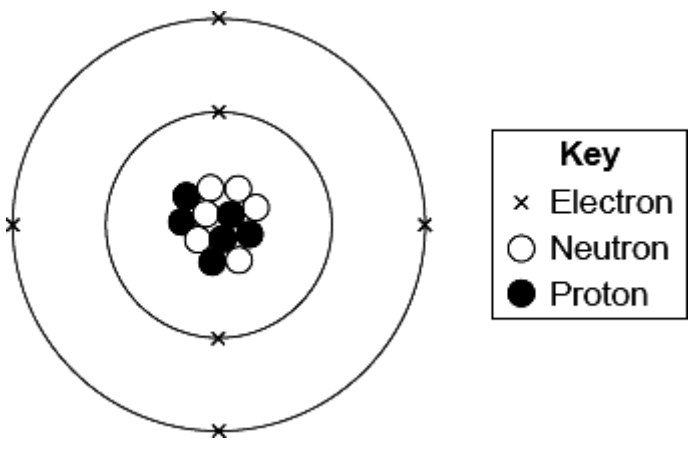
Explain why in terms of electronic structure.

(1)

(Total 8 marks)

Q42.

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)

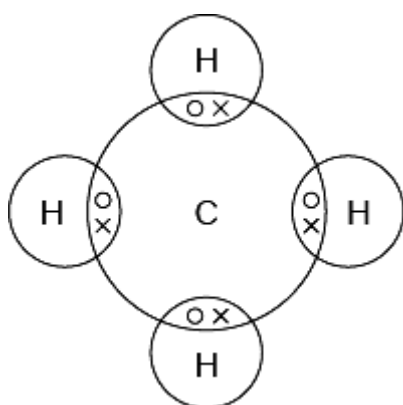
(c) A different carbon atom has 6 protons and 8 neutrons.

Draw a ring around the symbol that represents this atom.



(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)

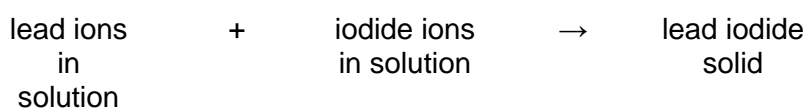
(Total 9 marks)

Q43.

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.

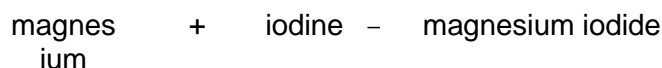
lead iodide

silver iodide

sodium iodide

(2)

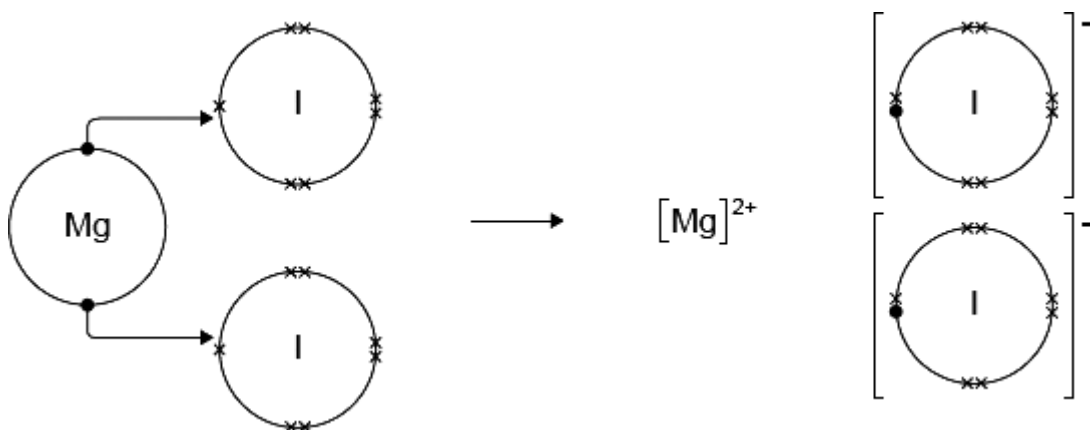
(b) Magnesium iodide can be made by reacting magnesium with iodine.



The diagram shows how this takes place.

Only the outer electrons are shown.

The dots (•) and crosses(x) 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.

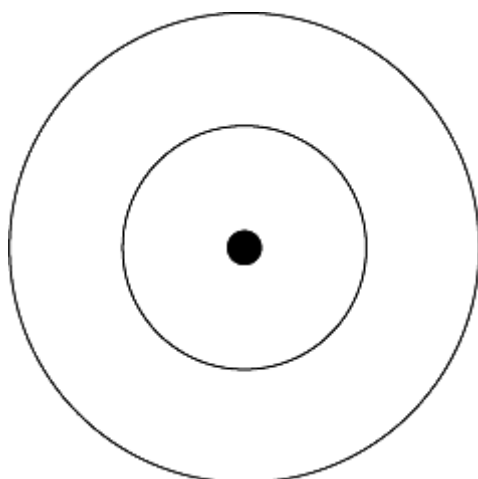
Q44.

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

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

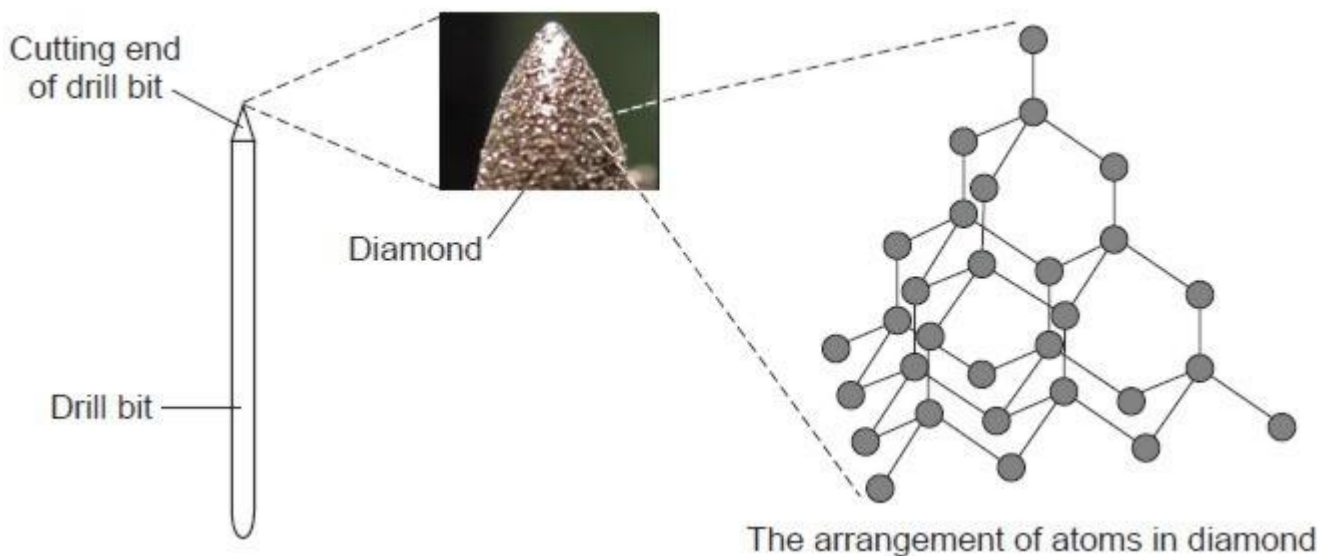
A carbon atom has 6 electrons.

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.

(3)

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

(3)

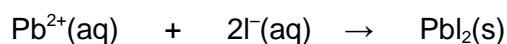
(Total 8 marks)

Q45.

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 _____

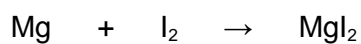
a soluble compound which contains iodide ions _____

(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.

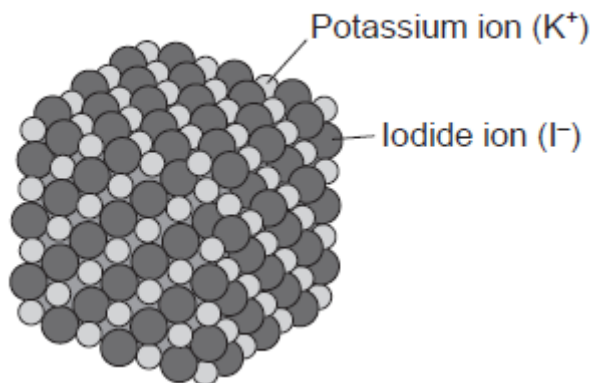


Magnesium iodide is an ionic compound. It contains magnesium ions (Mg^{2+}) and iodide ions (I^-).

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

(4)

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



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

(2)
(Total 9 marks)

