AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 3)

SCORE	PERCENTAGE
/233	%

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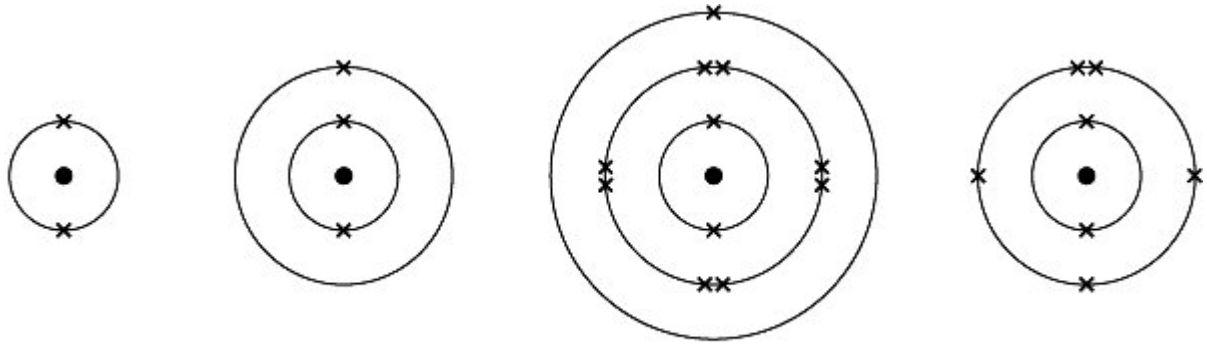
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Q1.

The diagrams show the electronic structure of four different atoms.



Atom A **Atom B** **Atom C** **Atom D**

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)

Q2.

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

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

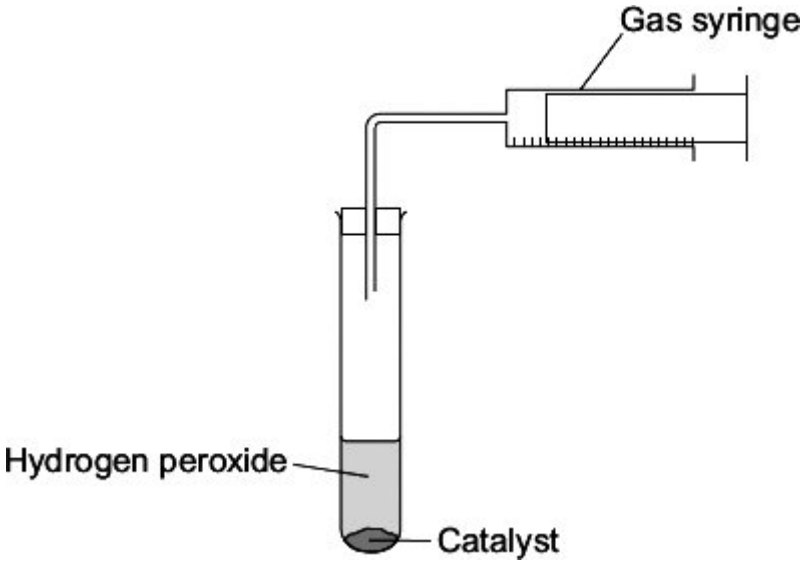
Complete the word equation for the decomposition of hydrogen peroxide.

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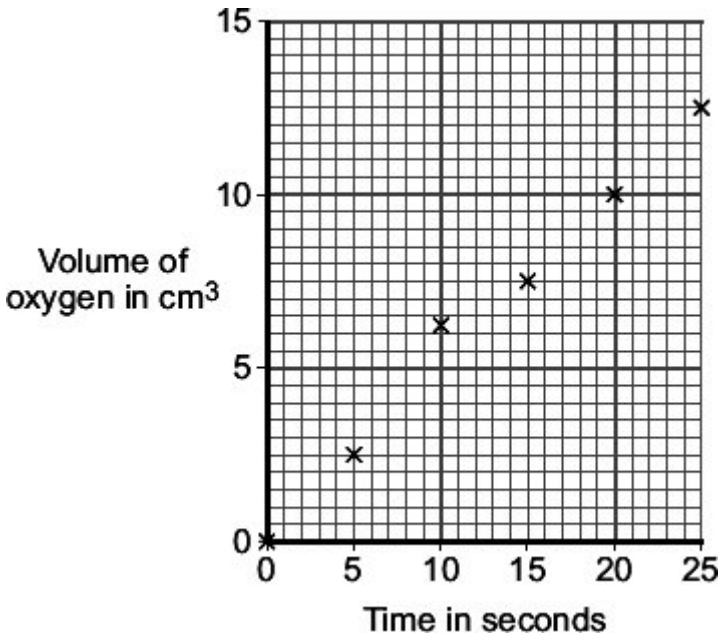
Hydrogen peroxide → _____ + _____

(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?

_____ cm^3

(1)

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

_____

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(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.

$$O=O$$

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)

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(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)

Q3.

Gold and gold ions are used as catalysts.

(a) An atom of gold is represented as:

$$^{197}_{79}\text{Au}$$

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.

$$Au \rightarrow Au^{3+} + 3e^-$$

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(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

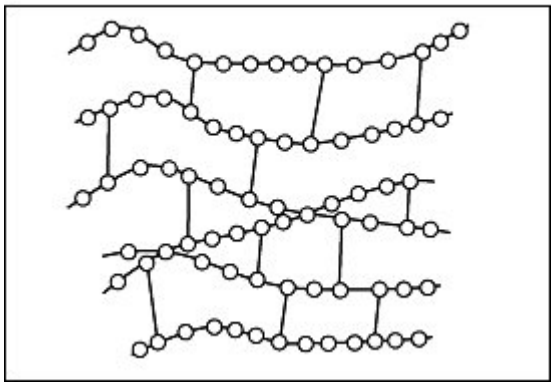
dissolve.
melt.
solidify.

(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?

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_____

_____

(1)

(Total 8 marks)

Q4.

This question is about gold (Au).

(a) An atom of gold is represented as:

$$^{197}_{79}\text{Au}$$

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 (Au^{3+})?

_____

_____

_____

_____

(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.

__ CO + _____ → ___ CO_2

(2)

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

Explain why.

_____

_____

_____

_____

_____

_____

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(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)

Q5.

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 $Ca(OH)_2$

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

_____

_____

_____

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(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.

$$CaO + H_2O \rightarrow Ca(OH)_2$$

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)

Q6.

Iron is extracted from its ore.

(a) Iron ore is quarried.

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Photograph supplied by Stockbyte/Thinkstock

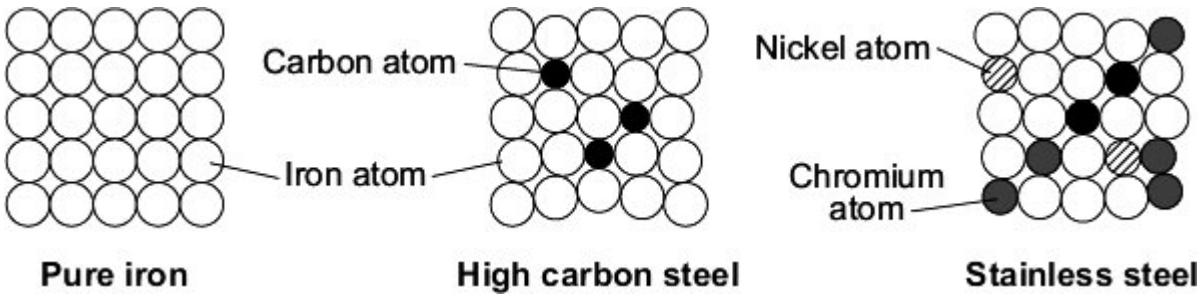
Quarrying iron ore has impacts that cause environmental problems.

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)

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(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.

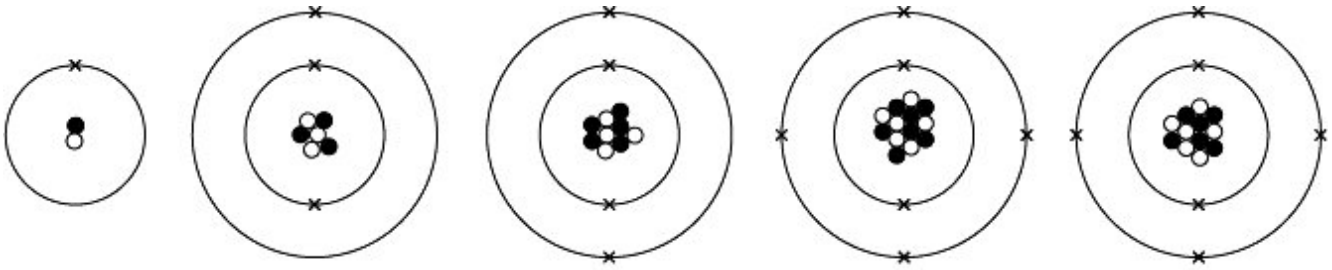
(1)

(Total 7 marks)

Q7.

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

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Atom A **Atom B** **Atom C** **Atom D** **Atom 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)

Q8.

Stage smoke is used for special effects at pop concerts.

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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.

$$NH_4Cl(s) \underset{\text{cooled}}{\overset{\text{heated}}{\rightleftharpoons}} NH_3(g) + HCl(g)$$

ammonium chloride (white)	ammonia (colourless)	hydrogen chloride (colourless)

(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	solid
black	liquid
white	gas

which is

ammonia.
ammonium chloride.
hydrogen chloride.

(4)

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(b) Complete the sentence.

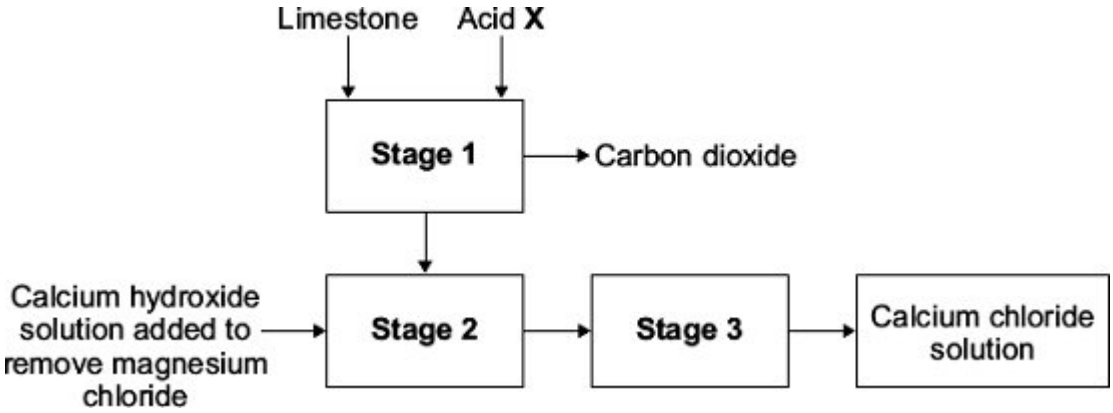
The symbol $\rightleftharpoons$ means that the reaction is _____

(1)

(Total 5 marks)

Q9.

(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:

$$MgCl_2(aq) + Ca(OH)_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$$

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

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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)

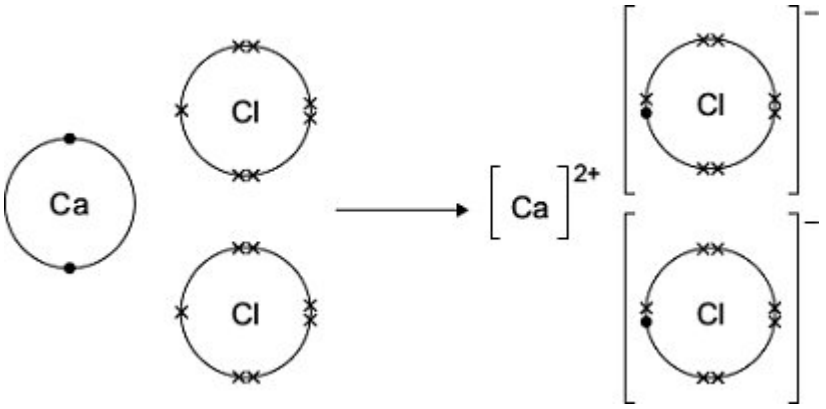
(b) Calcium chloride can also be made by reacting calcium with chlorine:

calcium + chlorine → calcium chloride

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.

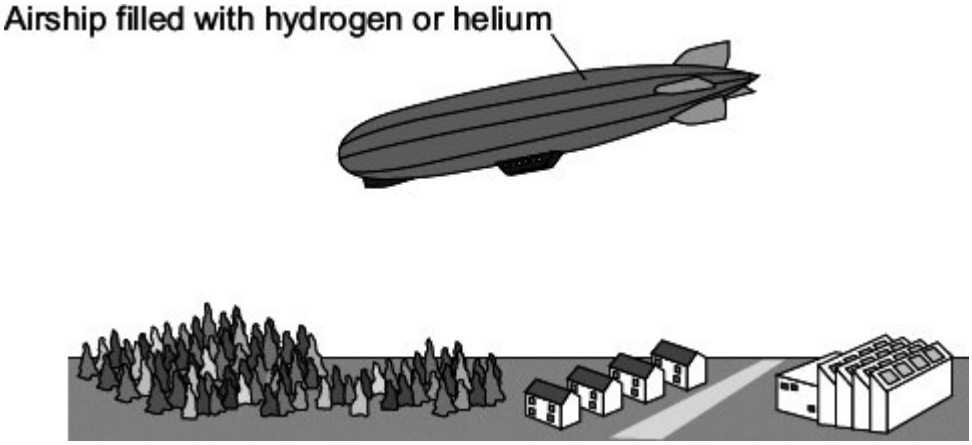
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(4)

(Total 8 marks)

Q10.

Hydrogen and helium have both been used in airships.



(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.

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

Complete the word equation for this reaction

hydrogen + oxygen → _____

(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.

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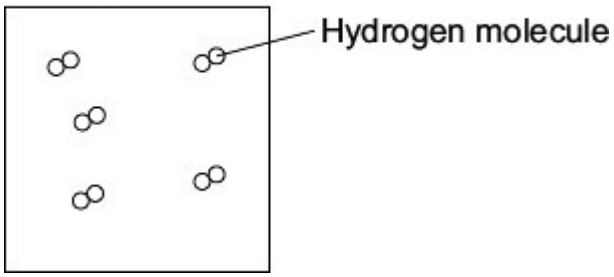
Helium is now used in airships because it is

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)

Q11.

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.

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(a) **Stage 1**
Titanium dioxide is converted into titanium chloride ($TiCl_4$) 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.

TiO_2 + Cl_2 + C → $TiCl_4$ + CO_2

(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.

$TiCl_4$ + 4Na → Ti + 4NaCl

(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.

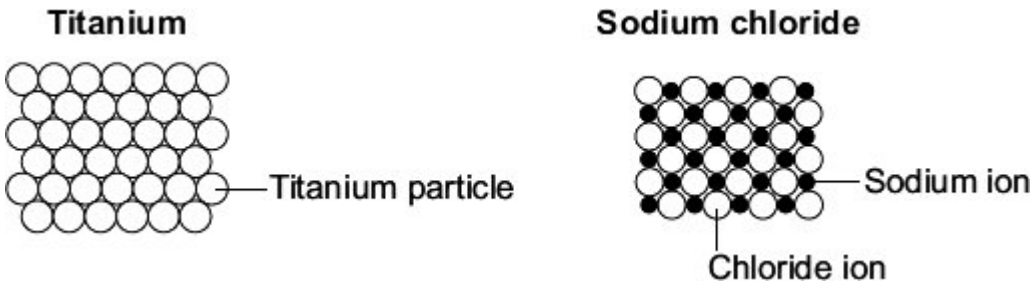
_____

_____

(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.

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How do the diagrams show that:

(i) titanium is an element

_____

_____

(1)

(ii) sodium chloride is a compound?

_____

_____

_____

_____

(2)

(Total 8 marks)

Q12.

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

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

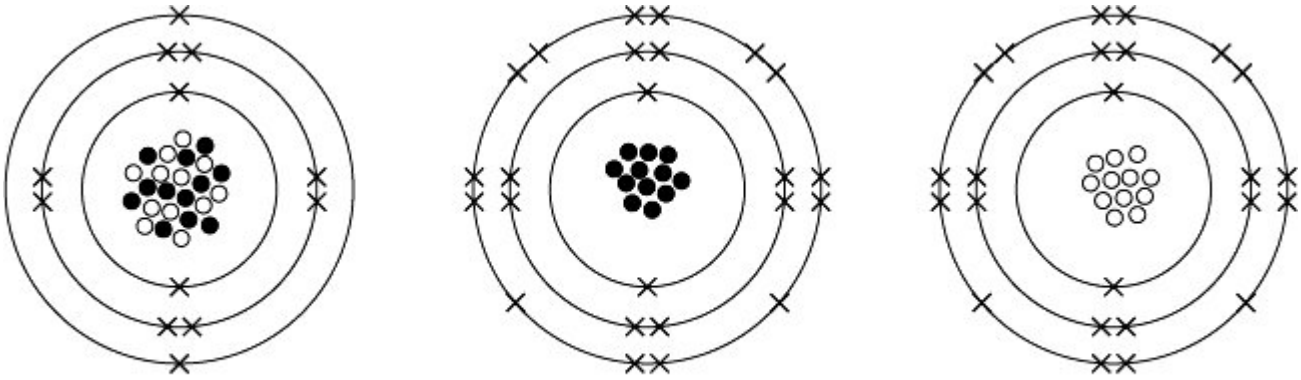


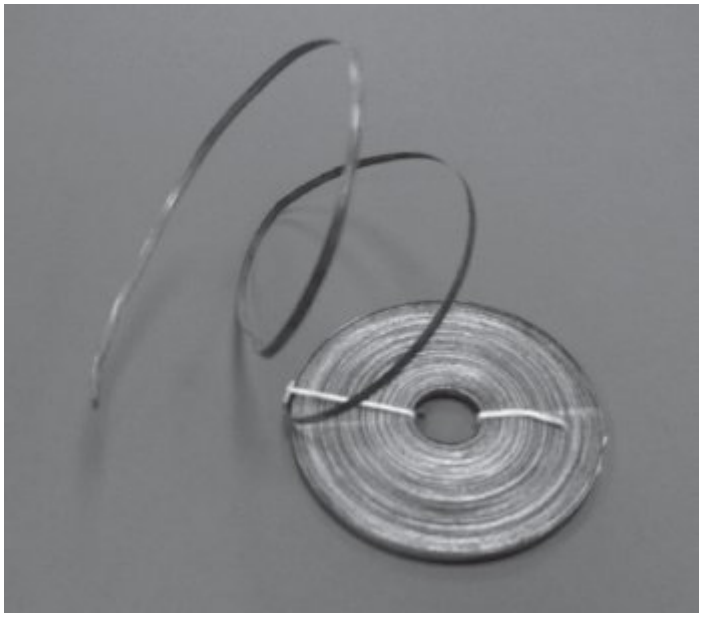
Diagram A **Diagram B** **Diagram C**

This magnesium atom is **Diagram** ☐

(1)

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

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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:

Mg(s)	+	H_2SO_4(aq)	→	$MgSO_4$(aq)	+	H_2(g)
magnesium		acid		magnesium sulfate solution		hydrogen

(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 (✓)

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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)

Q13.

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)

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(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+}).

_____

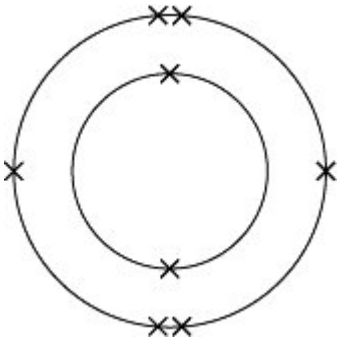
_____

_____

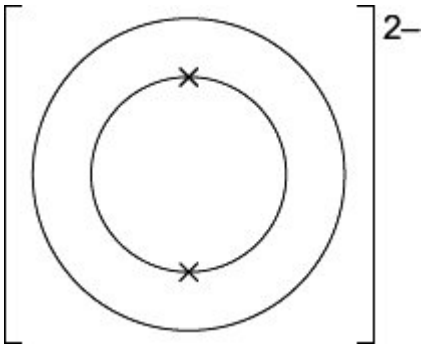
_____

(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-}).



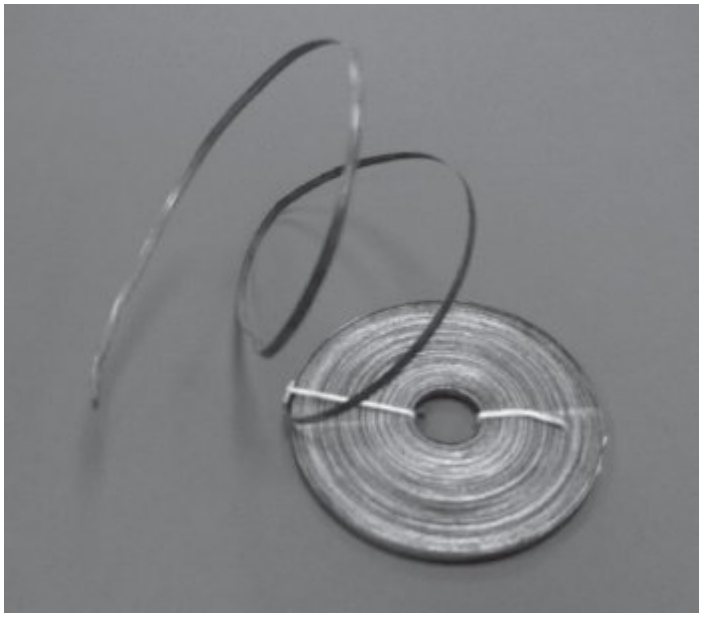
(1)

(Total 6 marks)

Q14.

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

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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:

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

(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.

_____

_____

_____

_____

_____

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(2)

(iii) The magnesium sulfate is in solution.

How could you obtain solid magnesium sulfate from this solution?

_____

_____

(1)

(Total 6 marks)

Q15.

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.

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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.

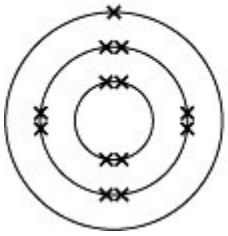
aluminium + _____ → _____

(1)

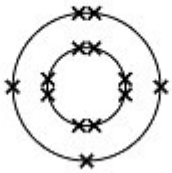
(d) An aluminium atom has 13 electrons.

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

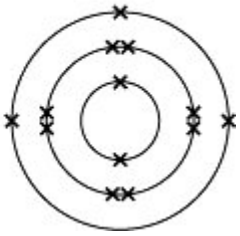
A



B



C



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] three electrons.

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shares

(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)

Q16.

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*.

What is the meaning of *exothermic*?

_____

_____

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(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)

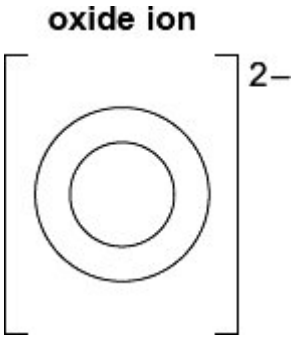
(c) The white smoke produced is aluminium oxide.

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)

Q17.

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

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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.

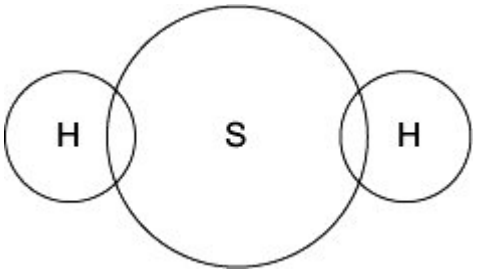
(i) Hydrogen sulfide has the formula H_2S. The bonding in a molecule of hydrogen sulfide can be represented as:

H–S–H

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.

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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).

$$PbS(s) + _____H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$$

(1)

(Total 8 marks)

Q18.

Natural gas is mainly a hydrocarbon called methane.

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

compounds	**elements**	**molecules**

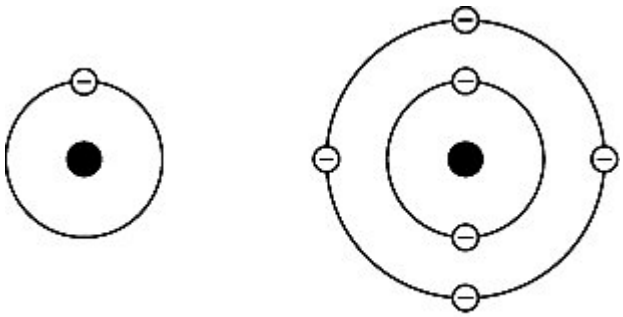
Hydrocarbons contain hydrogen and carbon only.

Hydrogen and carbon are _____ .

(1)

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

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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)

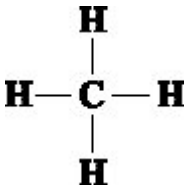
(ii) The hydrogen atom has one electron and the carbon atom has

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
CH_4
C_4H_4

(1)

(ii) The line between C—H is called a

bond.
molecule.
nucleus.

(1)

(d) Methane burns to produce carbon dioxide (CO_2) and water (H_2O).

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

When methane burns it reacts with

carbon.
nitrogen.
oxygen.

(1)

(ii) Hydrogen (H_2) can be used as a fuel.

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

_____

_____

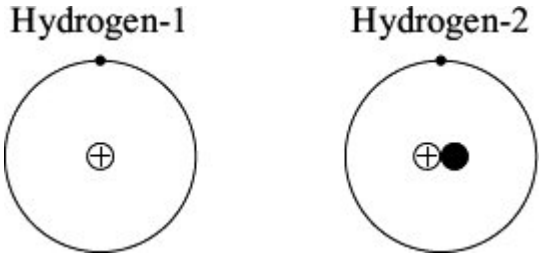
(1)

(Total 7 marks)

Q19.

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

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, ⊕ , in the nucleus of atoms are called

_____ .

(1)

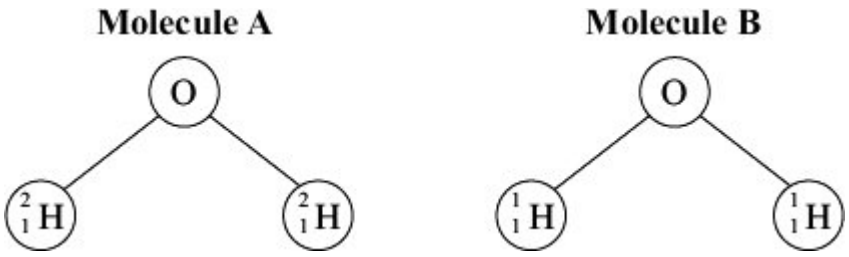
(ii) The particles with no charge, ● , in the nucleus of atoms are called

_____ .

(1)

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

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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)

Q20.

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.

calcium fluoride + sulfuric acid → calcium sulfate + hydrogen fluoride

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

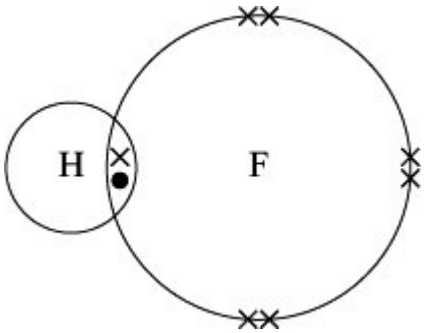
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the solid calcium fluoride should be [powder / lumps] to give a [small / big] surface area

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)

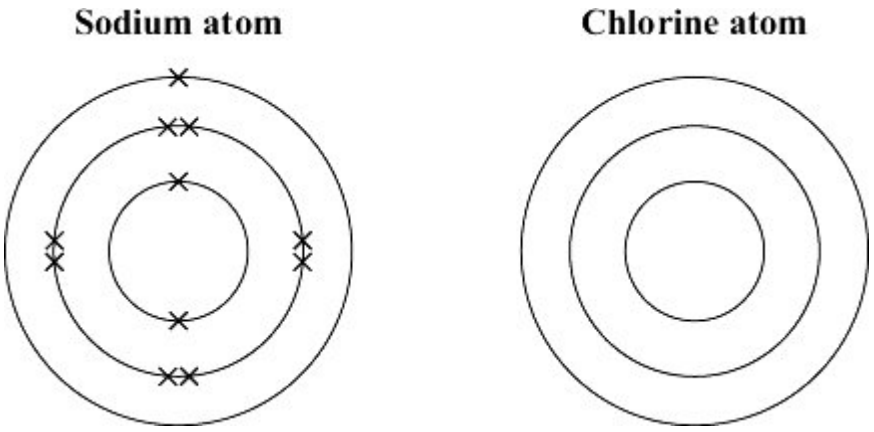
Q21.

Sodium chloride is a raw material.

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

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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?

_____

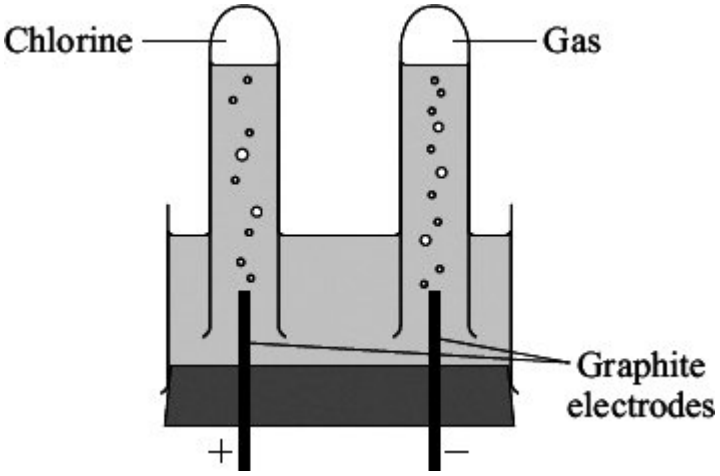
_____

_____

_____

(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)

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(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)

Q22.

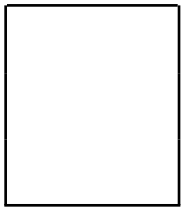
(a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

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

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An atom of hydrogen-1 is represented as: $^{1}_{1}H$

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.

_____

_____

_____

_____

_____

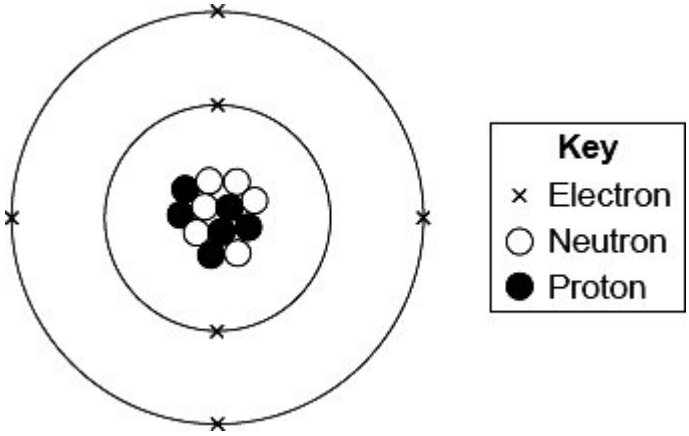
(2)

(Total 6 marks)

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Q23.

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.

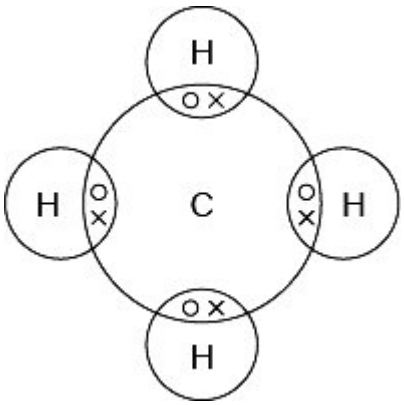
Draw a ring around the symbol that represents this atom.

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$^{8}_{6}C$ $^{14}_{6}C$ $^{14}_{8}C$

(1)

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



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

CH_4 **CH^4** **C_4H**

(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)

Q24.

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.

lead ions in solution	+	iodide ions in solution	→	lead iodide solid

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

electrolysis **neutralisation** **precipitation**

(1)

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(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.

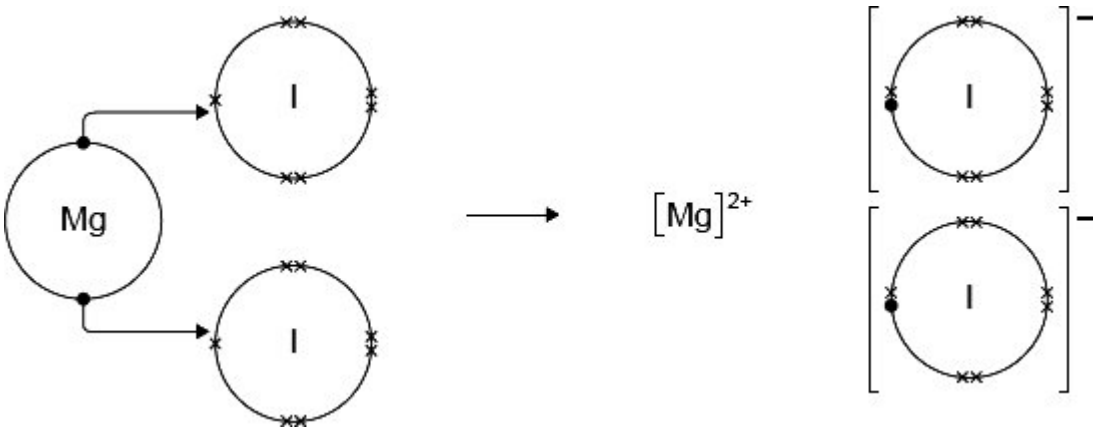
magnesium + iodine – magnesium iodide

The diagram shows how this takes place.

Only the outer electrons are shown.

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

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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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q25.

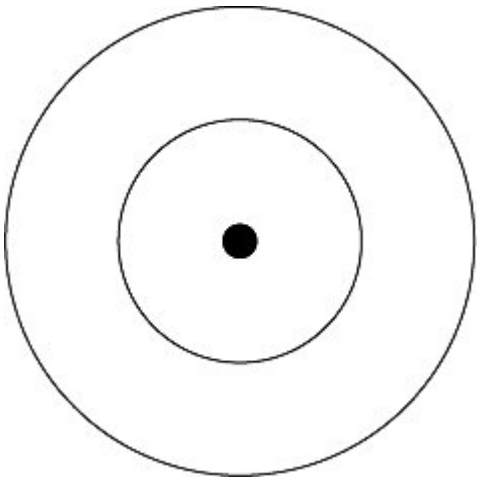
Pure carbon can exist in two forms, diamond and graphite.

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

A carbon atom has 6 electrons.

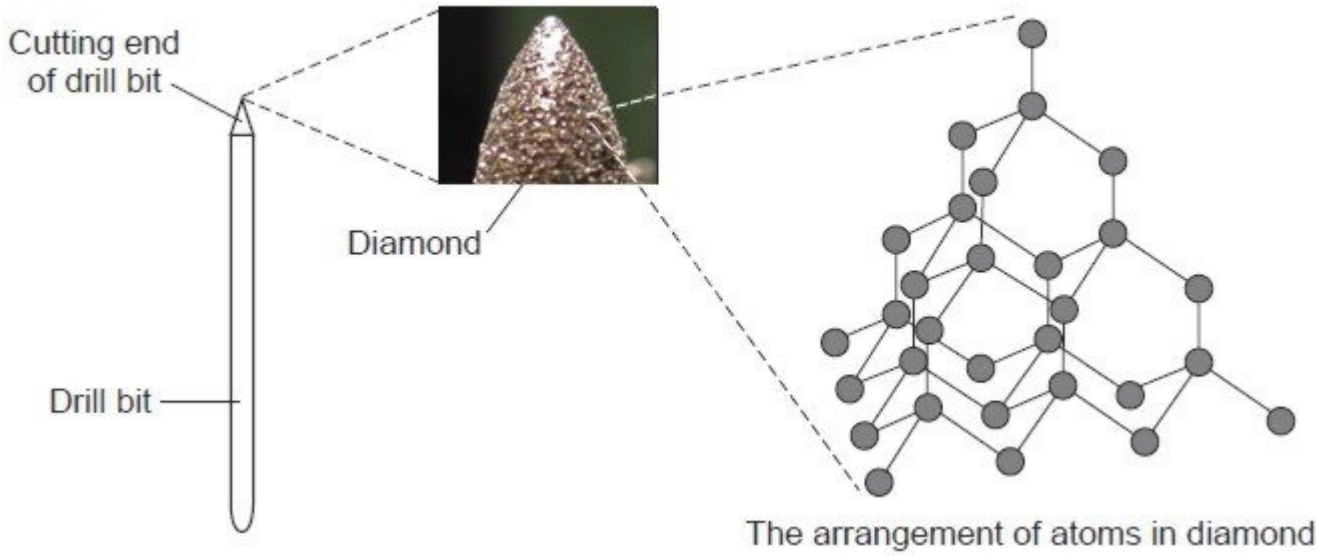
Show the electrons as crosses (x).

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(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.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q26.

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.

$$Pb^{2+}(aq) + 2I^{-}(aq) \rightarrow PbI_2(s)$$

(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 _____

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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.

$Mg + I_2 \rightarrow MgI_2$

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.

_____

_____

_____

_____

_____

_____

_____

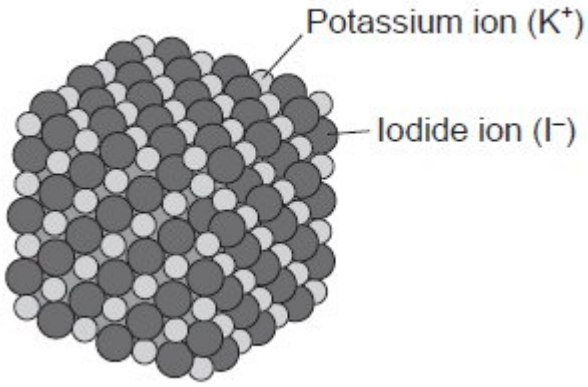
_____

_____

_____

(4)

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



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

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_____

_____

_____

_____

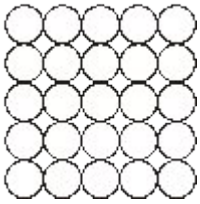
(2)

(Total 9 marks)

Q27.

Iron is the main structural metal used in the world.

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



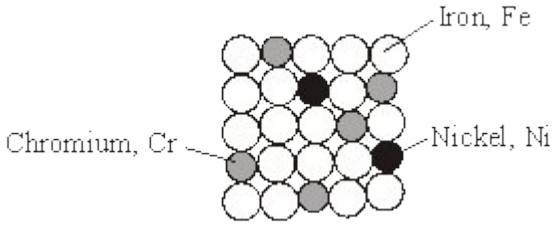
Draw a ring around the correct word in the box to complete the sentence.

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 _____ .

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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.

_____

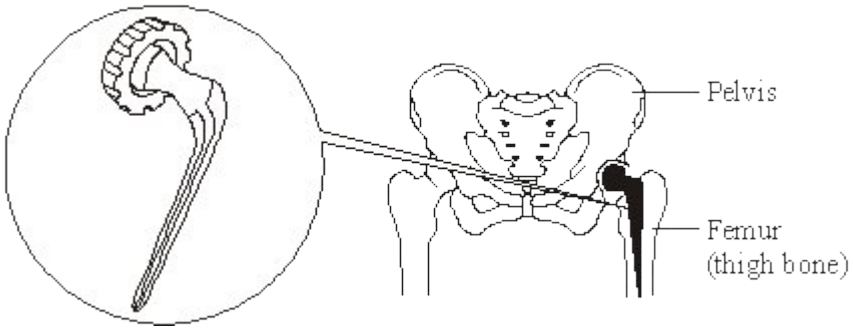
_____

(1)

(Total 8 marks)

Q28.

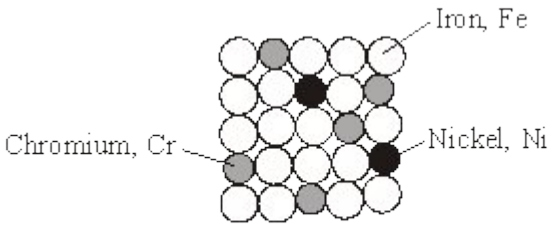
The hip joint between the femur and pelvis sometimes has to be replaced.
Early hip replacement joints were made from stainless steel.



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

The diagram below represents the particles in stainless steel.

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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.

_____

_____

_____

_____

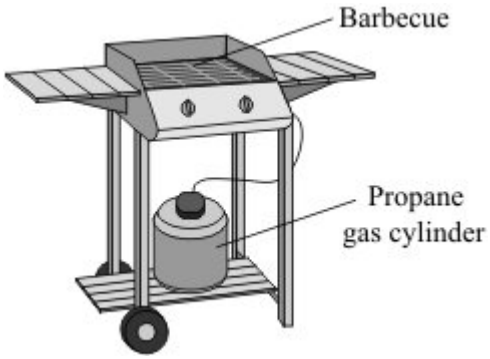
(2)

(Total 6 marks)

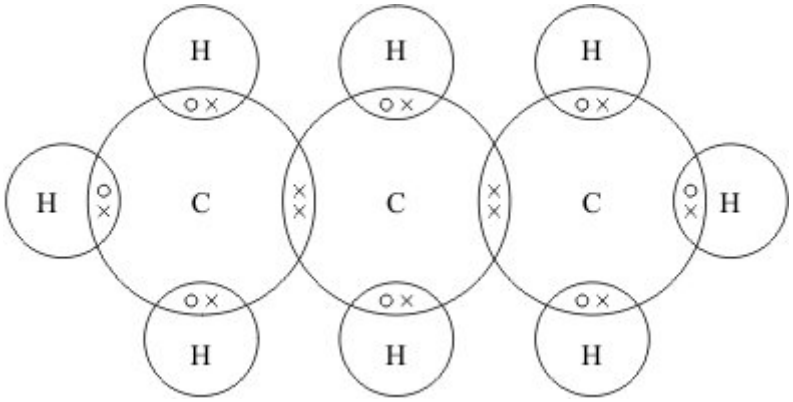
Q29.

This barbecue burns propane gas.

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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 ○ and × 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)

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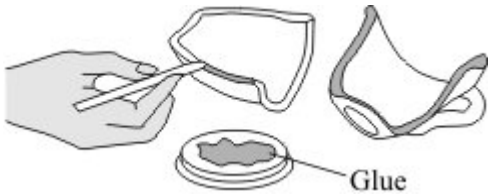
Q30.

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

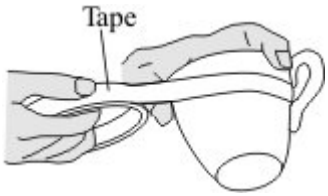
Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.



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.

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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)

Q31.

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.

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(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)

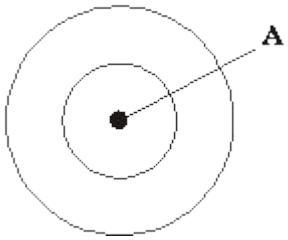
Q32.

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.

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(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.

$^{16}_{8}O$	$^{18}_{8}O$
oxygen-16	**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)

Q33.

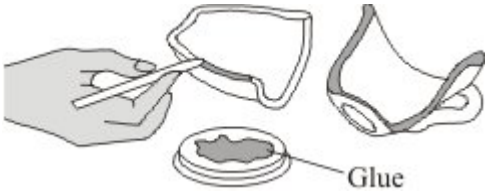
The following steps show how to use a type of glue.

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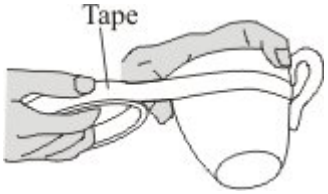


Step 2 Mix the liquids to make the glue.
Put a thin layer of the glue onto each of the surfaces to be joined.

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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.

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_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q34.

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 cm^3 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.

$C_7H_6O_3$ + $C_4H_6O_3$ → $C_9H_8O_4$ + CH_3COOH

salicylic acid — aspirin

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, $C_7H_6O_3$, is 138

The relative formula mass (M_r) of aspirin, $C_9H_8O_4$, is 180

_____

_____

_____

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_____

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.

_____

_____

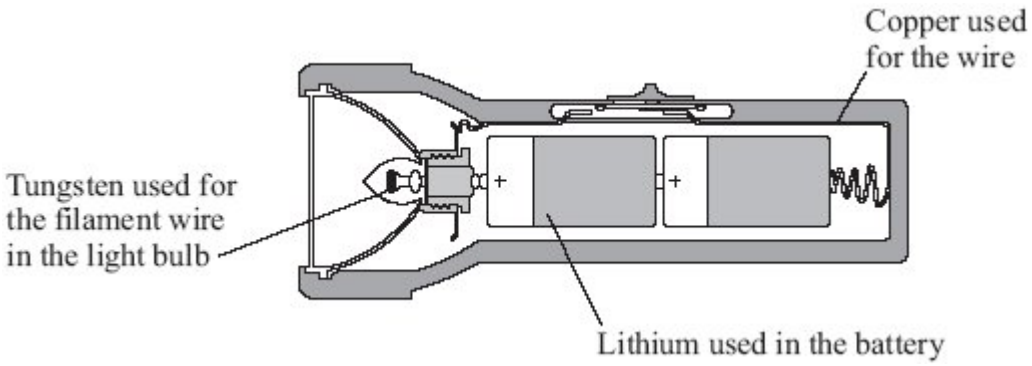
(1)

(Total 6 marks)

Q35.

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

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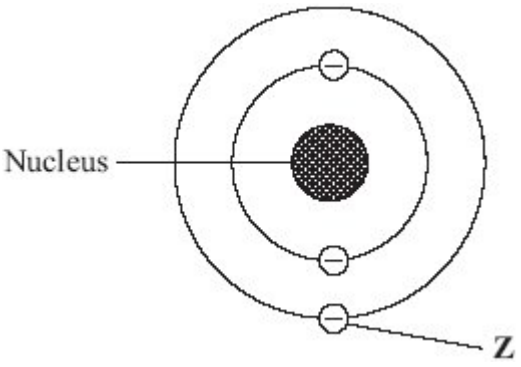


(a) Why is copper used for the wire?

_____

(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 _____

_____

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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)

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