Using resources

Q1.

This question is about mixtures and analysis.

(a) Which **two** substances are mixtures?

Tick **two** boxes.

Air	☐
Carbon dioxide	☐
Graphite	☐
Sodium Chloride	☐
Steel	☐

(2)

(b) Draw **one** line from each context to the correct meaning.

Context	Meaning
	A substance that has had nothing added to it
Pure substance in chemistry	A single element or a single compound
	A substance containing only atoms which have different numbers of protons
Pure substance in everyday life	A substance that can be separated by filtration
	A useful product made by mixing substances

(2)

(c) What is the test for chlorine gas?

Tick **one** box.

A glowing splint relights ☐

A lighted splint gives a pop ☐

Damp litmus paper turns white ☐

Limewater turns milky ☐

(1)

(d) A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

Tick **one** box.

Calcium ☐

Copper(II) ☐

Iron(II) ☐

Iron(III) ☐

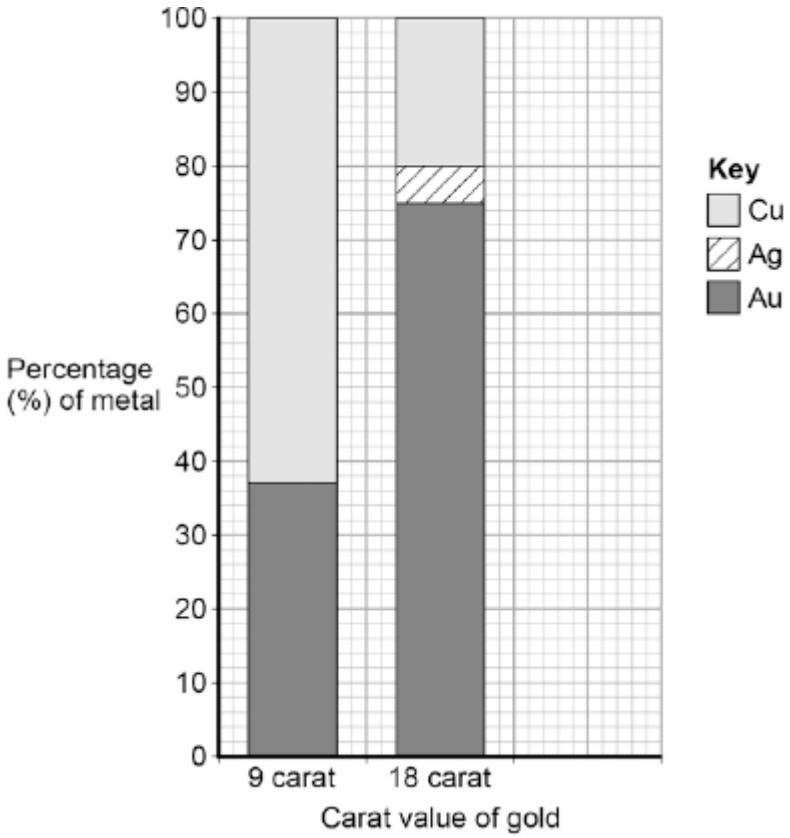
(1)

(Total 6 marks)

Q2.

Gold is mixed with other metals to make jewellery.

The figure below shows the composition of different carat values of gold.



(a) What is the percentage of gold in 12 carat gold?

Tick **one** box.

12 % ☐ **30 %** ☐ **50 %** ☐ **80 %** ☐

(1)

(b) Give the percentage of silver in 18 carat gold.

Use the figure above to answer this question.

Percentage = _____ %

(1)

(c) Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q3.

(a) Nitrogen and hydrogen are passed over iron to produce ammonia in the Haber Process.

Balance the equation for the reaction.

$$N_2 \quad + \quad H_2 \quad \rightarrow \quad NH_3$$

(1)

(b) What is iron used for in the Haber process?

Tick **one** box.

catalyst ☐

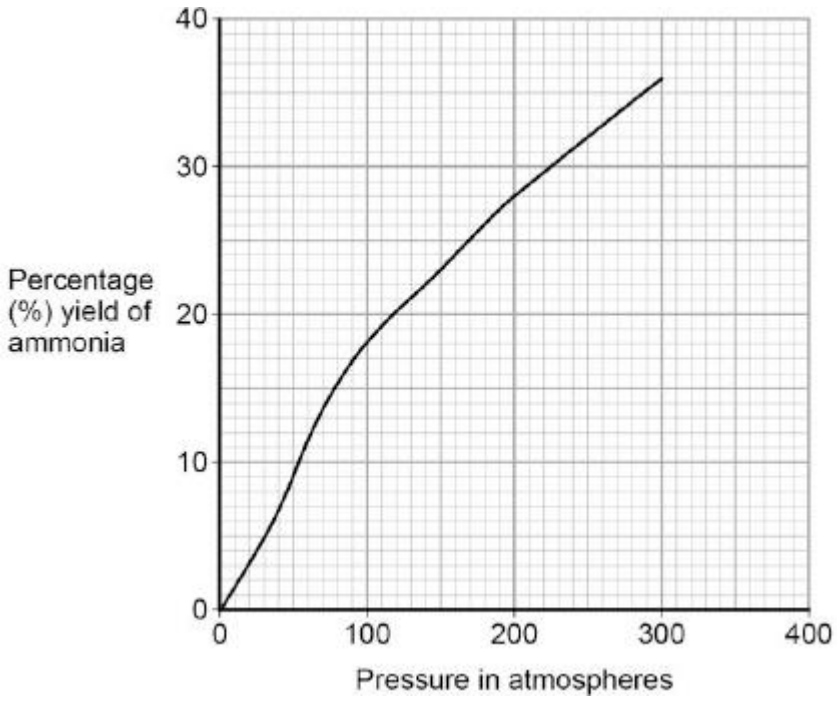
fuel ☐

monomer ☐

reactant ☐

(1)

(c) The figure below shows how the percentage yield of ammonia changes with pressure.



Describe the trend shown in the figure above.

_____

_____

(1)

(d) Use the figure above to determine the difference in percentage yield of ammonia at 150 atmospheres pressure and 250 atmospheres pressure.

Difference in percentage yield of ammonia = _____ %

(2)

(Total 5 marks)

Q4.

Water from a lake in the UK is used to produce drinking water.

(a) What are the two main steps used to treat water from lakes?

Give a reason for each step.

Step 1 _____

Reason _____

Step 2 _____

Reason _____

(2)

(b) Explain why it is more difficult to produce drinking water from waste water than from water in lakes.

_____

_____

_____

_____

_____

_____

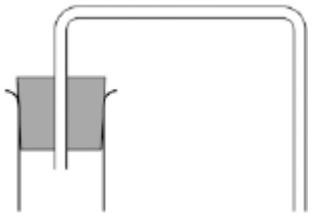
(3)

(c) Some countries make drinking water from sea water.

Complete the figure below to show how you can distil salt solution to produce and collect pure water.

Label the following:

- pure water
- salt solution



(3)

(d) How could the water be tested to show it is pure?

Give the expected result of the test for pure water.

_____

_____

_____

_____

_____

(2)

(e) Why is producing drinking water from sea water expensive?

_____

_____

(1)

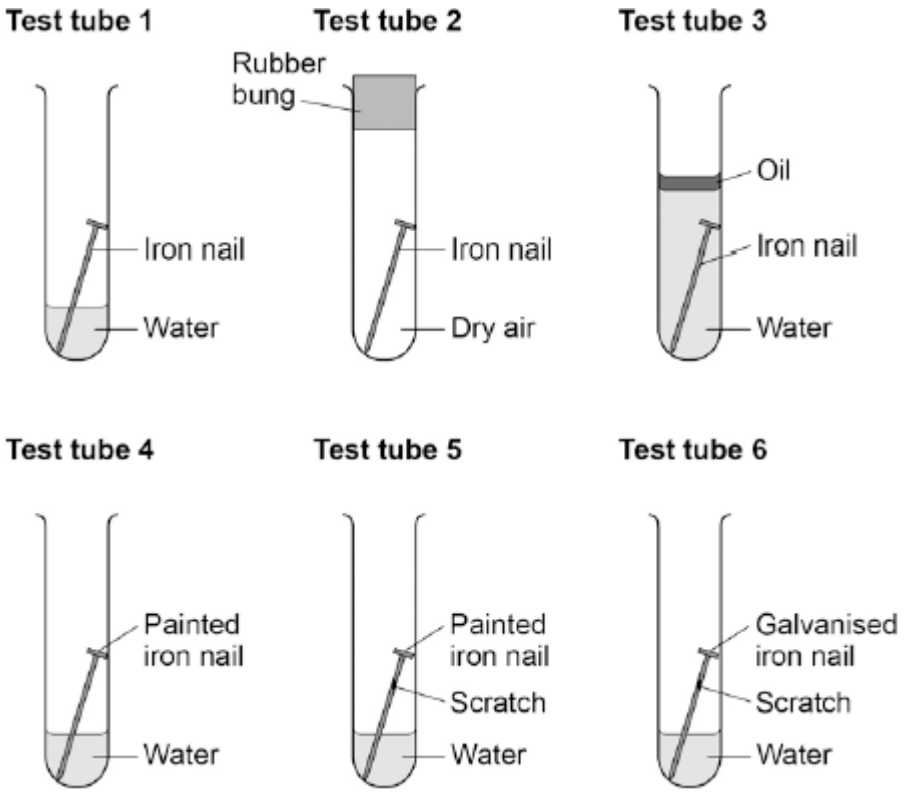
(Total 11 marks)

Q5.

The figure below shows six test tubes a student set up to investigate the rusting of iron.

This is the method used for each test tube.

1. Measure the mass of the nail using a balance.
2. Leave the nail in the test tube for 6 days.
3. Measure the mass of the nail after 6 days.



The table below shows the student's measurements.

Test tube	Mass of nail in g	Mass of nail after 6 days in g
1	8.45	8.91
2	8.46	8.46
3	8.51	8.51

4	9.65	9.65
5	9.37	9.45
6	9.79	9.79

(a) What is the resolution of the balance the student used?

Tick **one** box.

1×10^{-3} g ☐

1×10^{-2} g ☐

1×10^{-1} g ☐

1×10^{2} g ☐

(1)

(b) Calculate the difference in percentage increase in mass after 6 days of the nail in test tube **1** and the nail in test tube **5**.

Give your answer to **three** significant figures.

Difference in percentage increase in mass = _____ %

(4)

(c) Use the results of the student's investigations to draw conclusions about the factors affecting the rusting of iron. Include an evaluation of the effectiveness of different coatings at preventing the rusting of iron.

_____

_____

_____

_____

_____

(6)

(d) Rust is hydrated iron(III) oxide.

Complete the word equation for the reaction.

_____ + _____ + _____ → hydrated iron(III) oxide

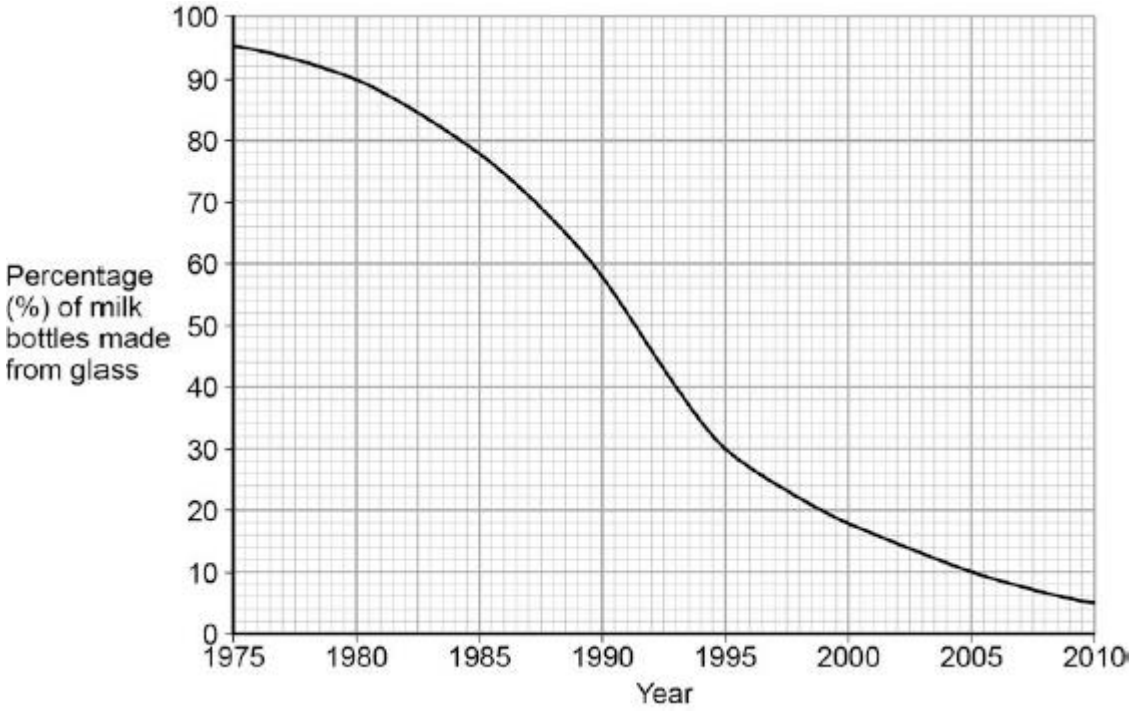
(2)

(Total 13 marks)

Q6.

Plastic and glass can be used to make milk bottles.

The figure below shows the percentage of milk bottles made from glass between 1975 and 2010.



(a) Plot the points and draw a line on the figure above to show the percentage of milk bottles made from materials **other** than glass between 1975 and 2010.

(3)

(b) The table below gives information about milk bottles.

	Glass milk bottle	**Plastic milk bottle**
Raw materials	Sand, limestone, salt	Crude oil

Bottle material	Soda-lime glass	HD poly(ethene)
Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.
Maximum temperature in production process	1600 °C	850 °C
Number of times bottle can be used for milk	25	1
Size(s) of bottle	0.5 dm^3	0.5 dm^3, 1 dm^3, 2 dm^3, 3 dm^3
Percentage (%) of recycled material used in new bottles	50 %	10 %

Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

(6)

(Total 9 marks)

Q7.

Fertilisers are used to improve agricultural productivity.

(a) Ammonium nitrate is used in fertilisers.

Name the **two** compounds used to manufacture ammonium nitrate.

(1)

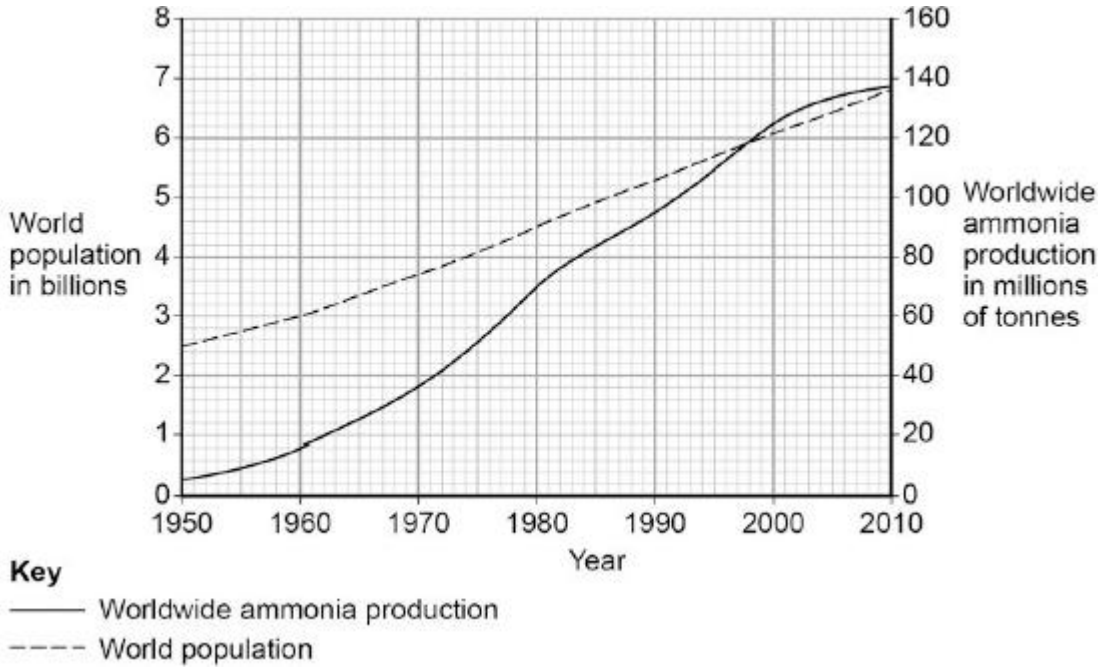
(b) A fertiliser contains the following information on the label:

NPK value = 14 : 11 : 11

Explain why this information is useful to farmers.

(2)

(c) The figure below shows worldwide ammonia production and world population from 1950 to 2010.



Use the figure above and your knowledge to explain the relationship between ammonia production and world population.

(3)

(Total 6 marks)

Q8.

Metals are extracted from ores in the Earth's crust.

(a) Why is copper used in the manufacture of computers?

Tick (✔) **one** box.

Because it has a high density. ☐

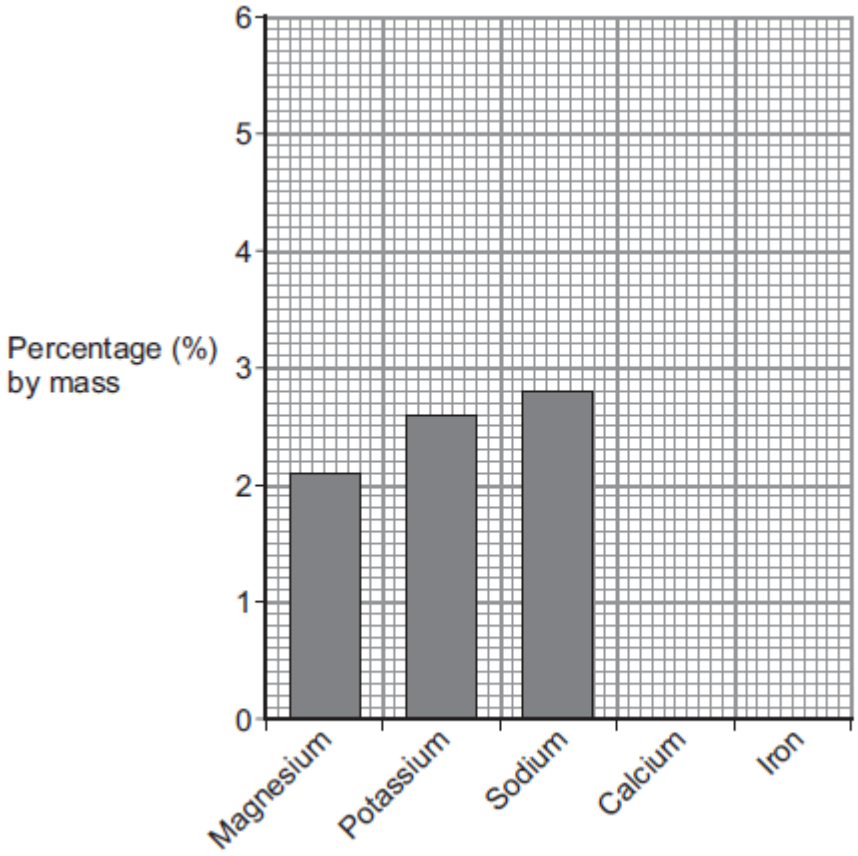
Because it does not react with water. ☐

Because it is a good conductor of electricity. ☐

(1)

(b) **Figure 1** shows the percentage (%) by mass of some metals in the Earth's crust.

Figure 1



(i) What is the percentage by mass of magnesium in the Earth's crust?

_____ %

(1)

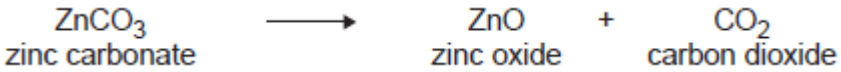
(ii) On **Figure 1** draw the bars for:

- calcium at 3.6% by mass
- iron at 5.0% by mass.

(2)

(c) An ore of zinc contains zinc carbonate.

The equation for the reaction when zinc carbonate is heated is:



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

Tick (✔) **one** box.

corrosion ☐

decomposition ☐

electrolysis ☐

(1)

(ii) Which substance in the equation is a gas at room temperature (20 °C)?

Tick (✔) **one** box.

zinc carbonate ☐

zinc oxide ☐

carbon dioxide ☐

(1)

(iii) Complete the table below to show the number of atoms of carbon and oxygen in the formula of zinc carbonate.

Element	**Number of atoms in the formula $ZnCO_3$**
zinc, Zn	1
carbon, C	
oxygen, O	

(2)

(iv) When 125 g zinc carbonate is heated, 81 g zinc oxide is produced.

Calculate the mass of carbon dioxide produced.

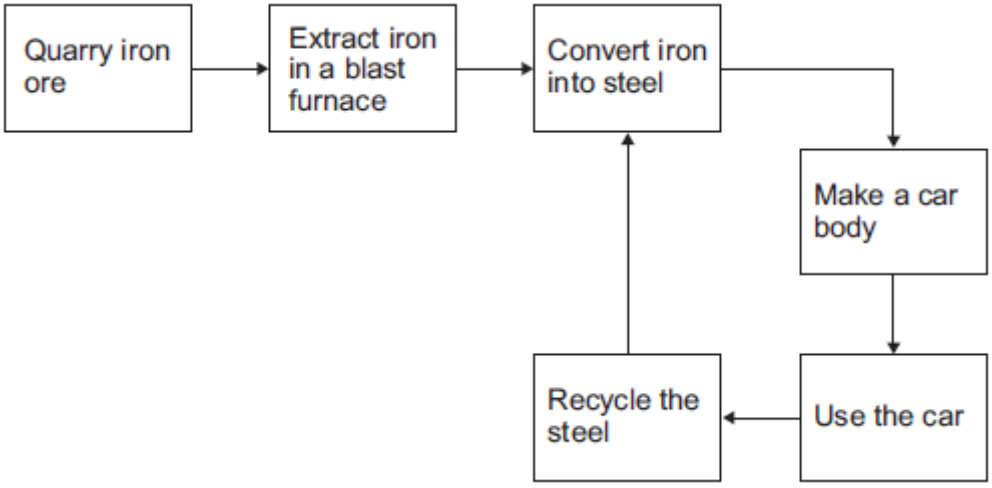
_____

Mass of carbon dioxide = _____g

(1)

(d) **Figure 2** shows a simple life cycle of a car body.

Figure 2



(i) What is **one** reason why iron from the blast furnace is converted into steel?

Tick (✔) **one** box.

To make the iron pure. ☐

To make the iron more brittle. ☐

To make alloys for specific uses. ☐

(1)

(ii) Apart from cost, give **three different** reasons why steel should be recycled.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 13 marks)

Q9.

Metals are extracted from ores in the Earth's crust.

Some ores contain metal carbonates and some ores contain metal oxides.

(a) (i) Name the type of reaction that happens when a metal carbonate is heated.

_____

(1)

(ii) Which solid product is formed when copper carbonate is heated?

Tick (✔) **one** box.

copper

copper nitrate

copper oxide

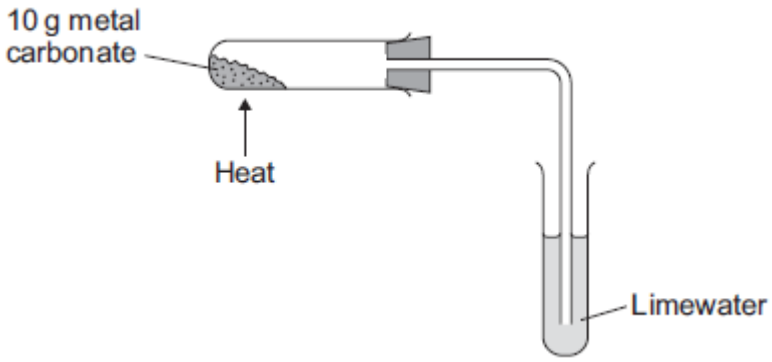
copper sulfide

(1)

(b) A student investigated heating four metal carbonates.

Figure 1 shows the apparatus used.

Figure 1



The student heated each metal carbonate for five minutes.

The table below shows the results.

Metal carbonate	**Mass of metal carbonate at start in g**	**Mass of solid after heating for 5 minutes in g**	**Observations**
Copper carbonate	10.0	6.9	Limewater turns cloudy
Magnesium carbonate	10.0	9.1	Limewater turns cloudy
Potassium carbonate	10.0	10.0	Limewater does not turn cloudy
Zinc carbonate	10.0	8.3	Limewater turns cloudy

(i) Explain the results for potassium carbonate.

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Suggest how the reactivity series can be used to predict which metal carbonate reacts most easily when heated.

_____

_____

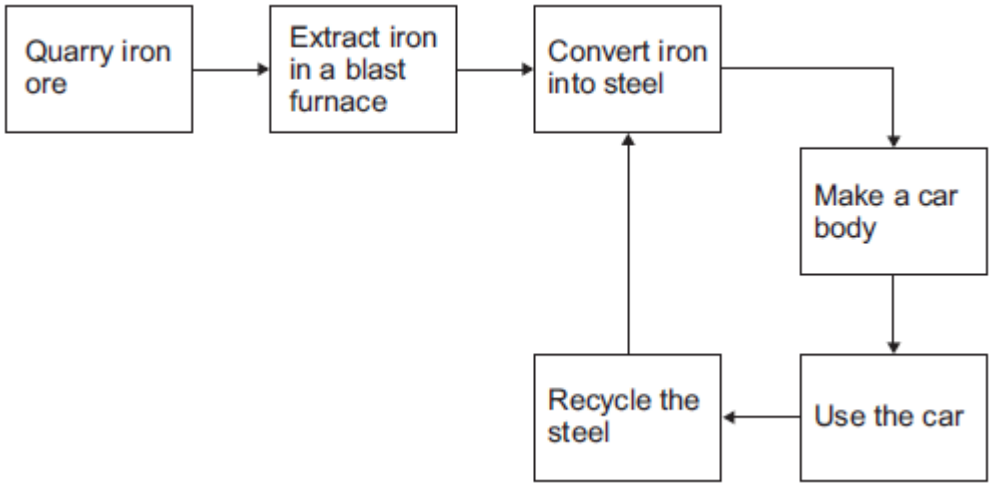
_____

_____

(2)

(c) **Figure 2** shows a simple life cycle of a car body.

Figure 2



(i) Complete the sentence.

Iron ores must contain enough iron to _____

_____

(1)

(ii) Some iron ores contain iron oxide (Fe_2O_3).

Complete and balance the equation for a reaction to produce iron from iron oxide.

_____ Fe_2O_3 + _____ C $\longrightarrow$ _____ + _____ CO_2

(2)

(iii) Give **two** reasons why iron produced in a blast furnace is converted into steel.

_____

_____

_____

_____

(2)

(iv) When a car reaches the end of its useful life, the car body can be:

- recycled
- reused
- sent to landfill.

Give **three** reasons why a steel car body should be recycled and **not** reused or sent to landfill.

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)

Q10.

This question is about substances containing carbon atoms.

(a) Diamond is made of carbon atoms.

(i) Diamond is used for tips of drills.

Figure 1 shows a drill.

Figure 1

© Kershawj/iStock

Give **one** reason why diamond is used for tips of drills.

_____

_____

(1)

(ii) Diamond nanoparticles can be made.

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

hundred	**million**	**thousand**

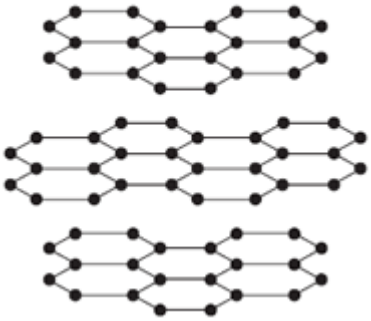
Nanoparticles contain a few _____ atoms.

(1)

(b) Graphite is made of carbon atoms.

Figure 2 shows the structure of graphite.

Figure 2



(i) What type of bonding does graphite have?

Tick (✔) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

(ii) How many carbon atoms does each carbon atom bond to in graphite?

Tick (✔) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

(1)

(iii) What is a property of graphite?

Tick (✔) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

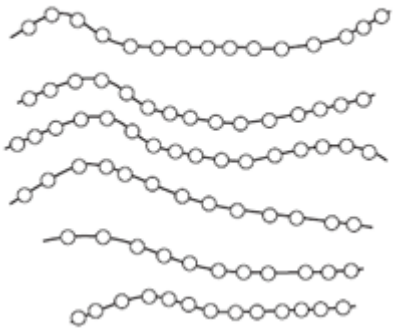
(1)

(c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 3 shows the structure of a thermosoftening polymer.

Figure 3



(i) Complete the sentence.

Between the polymer chains in a thermosoftening polymer there

are no _____ .

(1)

(ii) Use the correct answer from the box to complete the sentence.

condense	**dissolve**	**melt**

Heating would cause a thermosoftening polymer to

_____ .

(1)

(iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction.
Suggest **two** conditions that could be changed.

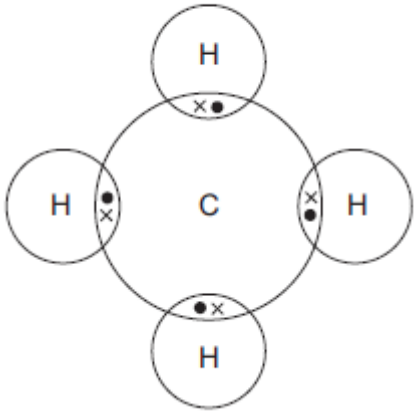
1. _____

2. _____

(2)

(d) **Figure 4** shows how the atoms are bonded in methane.

Figure 4



(i) What is the formula for methane?

Tick (✔) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

(1)

(ii) Methane has a low boiling point.

What does methane consist of?

Tick (✔) **one** box.

Charged ions ☐

A giant lattice ☐

Small molecules ☐

(1)

(Total 11 marks)

Q11.

This question is about ammonia and fertilisers.

(a) Ammonia is produced by a reversible reaction.

The equation for the reaction is:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Complete the sentence.

The forward reaction is exothermic, so the reverse reaction

is _____

(1)

(b) Calculate the percentage by mass of nitrogen in ammonia (NH_3).
Relative atomic masses (A_r): H = 1; N = 14
You **must** show how you work out your answer.

_____

_____

_____

_____

_____

_____

Percentage by mass of nitrogen = _____ %

(3)

(c) A neutral solution can be produced when ammonia reacts with an acid.

(i) Give the pH of a neutral solution.

pH _____

(1)

(ii) Which of these ionic equations shows a neutralisation reaction?

Tick (✔) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

(1)

(iii) Name the salt produced when ammonia reacts with hydrochloric acid.

_____

(1)

(d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

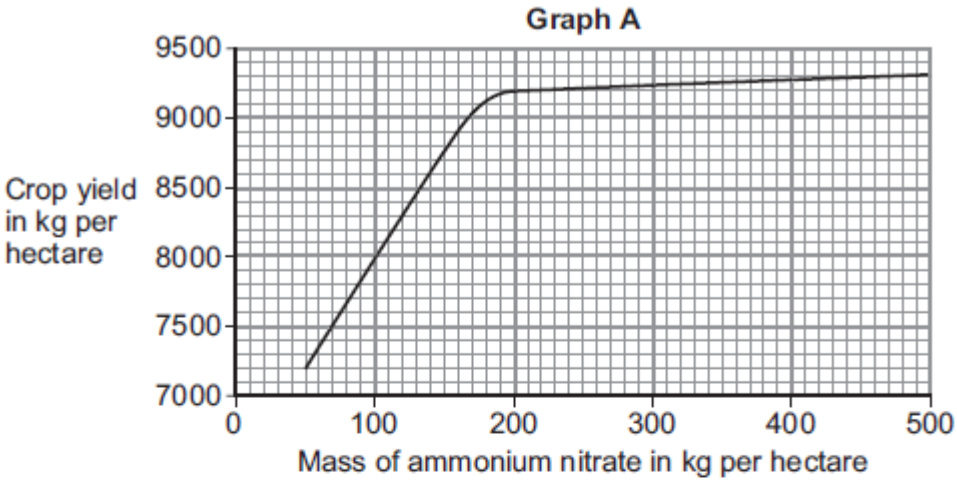
Farmers use ammonium nitrate as a fertiliser for crops.

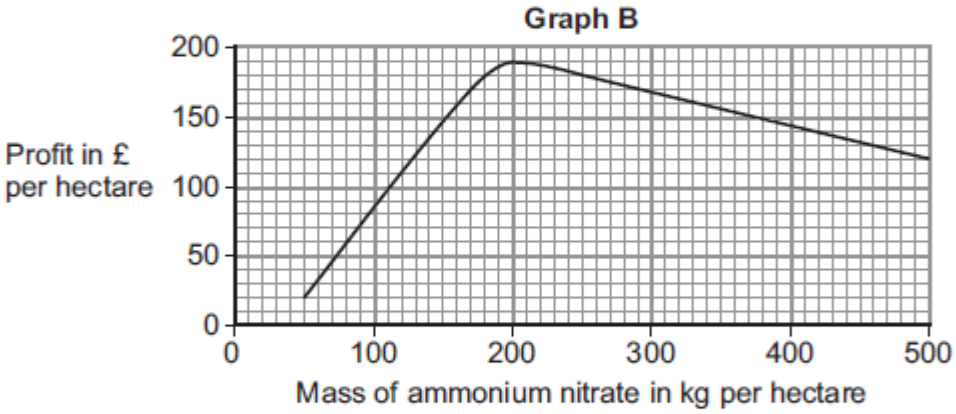
Rainwater dissolves ammonium nitrate in the soil.

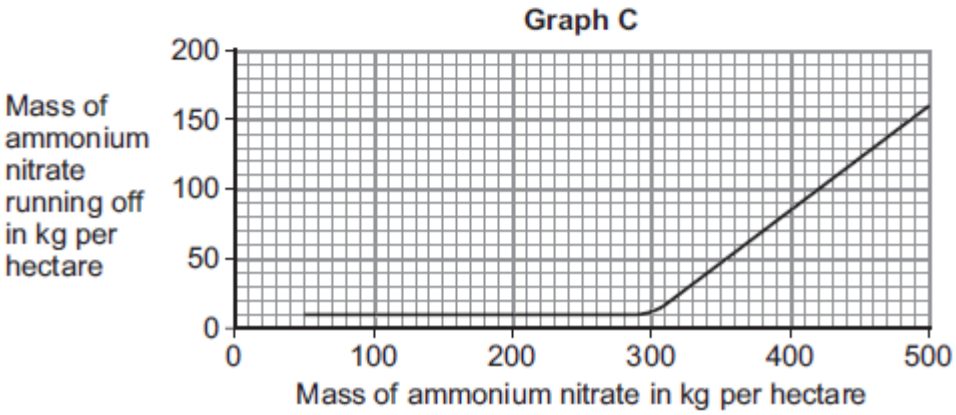
Some of the dissolved ammonium nitrate runs off into rivers and lakes.

The graphs **A**, **B** and **C** below show information about the use of ammonium nitrate

as a fertiliser. A hectare is a measurement of an area of land.







Suggest how much ammonium nitrate farmers should use per hectare.

Give reasons for your answer.

Use information from graphs **A**, **B** and **C**.

_____

_____

_____

_____

_____

(6)

(Total 13 marks)

Q12.

This question is about the properties and uses of materials.

Use your knowledge of structure and bonding to answer the questions.

(a) Explain how copper conducts electricity.

(2)

(b) Explain why diamond is hard.

(2)

(c) Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

_____

_____

_____

_____

_____

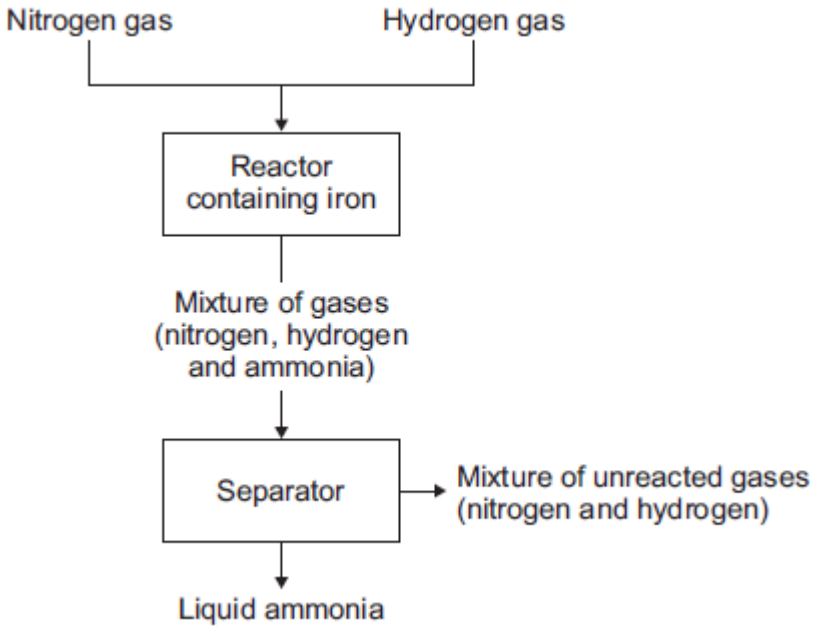
(2)

(Total 6 marks)

Q13.

This question is about the Haber process.

The diagram below shows a flow diagram for the Haber process.



(a) (i) Nitrogen gas and hydrogen gas are obtained from different sources.
Draw **one** line from each gas to its source.

Gas	Source
	Air
Nitrogen	Iron ore
Hydrogen	Limestone
	Natural gas

(2)

(ii) Explain why iron is used in the reactor for the Haber process.

_____

_____

_____

(2)

(iii) Describe how the ammonia is separated from the other gases.

_____

_____

_____

(2)

(iv) What happens to the mixture of unreacted gases (nitrogen and hydrogen)?

_____

_____

_____

(1)

(b) The reaction to produce ammonia is reversible.

Complete the word equation for this reaction.

nitrogen + _____

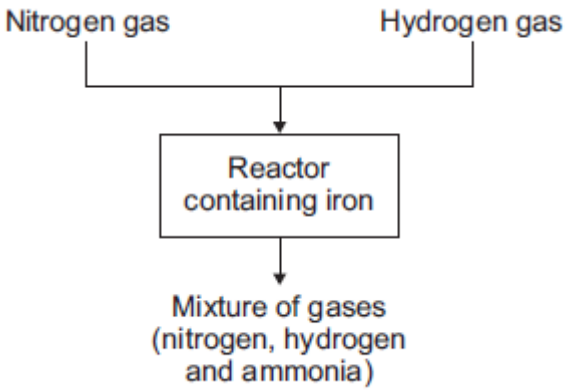
(2)

(Total 9 marks)

Q14.

The graph in **Figure 1** shows a flow diagram for the Haber process.

Figure 1



(a) (i) Hydrogen gas is obtained from methane.
Name **one** source of methane.

_____

(1)

(ii) Air is the source used to produce nitrogen for the Haber process.
Suggest why air must **not** get into the reactor.

_____

_____

_____

(2)

(iii) Describe what happens to the mixture of gases from the reactor.

_____

_____

_____

_____

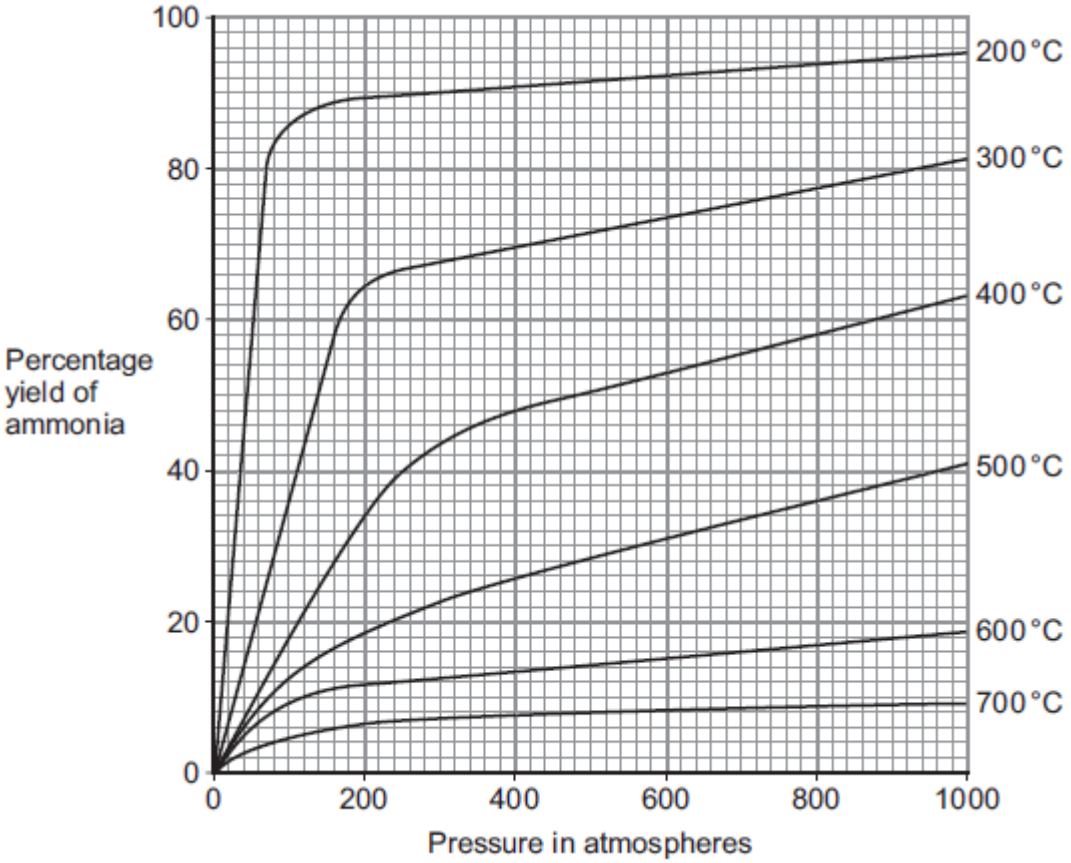
_____

_____

(3)

(b) The graph in **Figure 2** shows the percentage yield of ammonia using different conditions.

Figure 2



(i) Use **Figure 2** to suggest the conditions that produce the greatest yield of ammonia.

(1)

(ii) Use **Figure 2** to suggest and explain why the conditions used to produce ammonia in the Haber process are a temperature of 450 °C and a pressure of 200 atmospheres.

_____

_____

_____

_____

(5)

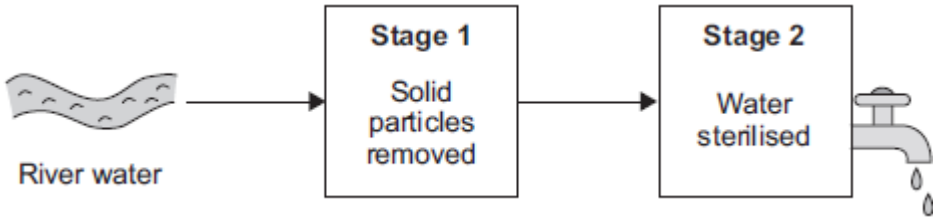
(Total 12 marks)

Q15.

This question is about water.

River water needs to be treated before it is safe to drink.

(a) The diagram shows two stages of the treatment of river water.



(i) What is the name of the process used to remove solid particles in **Stage 1**?

Tick (✓) **one** box.

Crystallisation ☐

Fermentation ☐

Filtration ☐

(1)

(ii) What is added in **Stage 2** to sterilise the water?

Tick (✓) **one** box.

Chlorine ☐

Fluoride ☐

Potassium ☐

(1)

(b) Toxic substances in river water are removed by adding very small amounts of iron oxide nanoparticles.

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

_____

_____

(1)

(ii) Nanoparticles are needed in only very small amounts.

Suggest why.

_____

_____

(1)

(c) In certain areas of the UK, tap water contains aluminium ions.

What would you **see** when sodium hydroxide solution is added drop by drop to tap water containing aluminium ions?

_____

_____

_____

_____

(2)

(Total 6 marks)

Q16.

This question is about copper.

(a) Copper can be extracted by smelting copper-rich ores in a furnace.

The equation for one of the reactions in the smelting process is:

$$Cu_2S(s) + O_2(g) \longrightarrow 2\ Cu(s) + SO_2(g)$$

Explain why there would be an environmental problem if sulfur dioxide gas escaped into the atmosphere.

_____

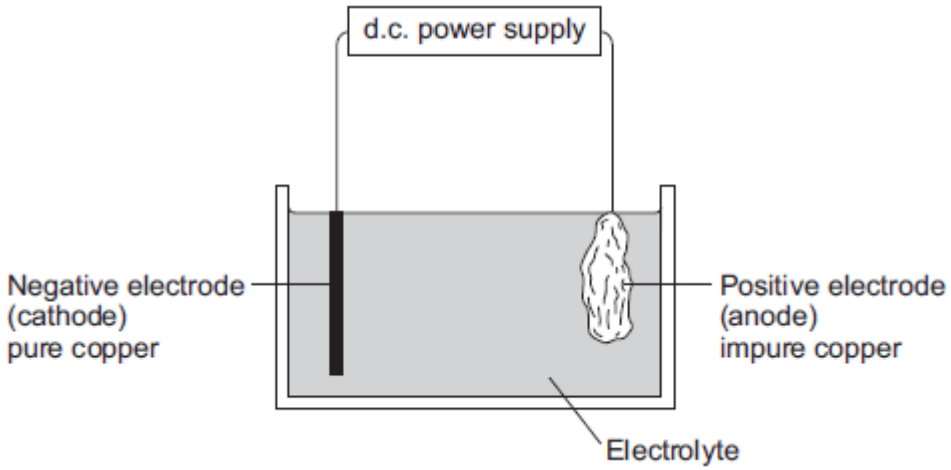
_____

_____

_____

(2)

(b) The impure copper produced by smelting is purified by electrolysis, as shown below.



Copper atoms are oxidised at the positive electrode to Cu^{2+} ions, as shown in the half equation.

$$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^{-}$$

(i) How does the half equation show that copper atoms are oxidised?

_____

_____

(1)

(ii) The Cu^{2+} ions are attracted to the negative electrode, where they are reduced to produce copper atoms.

Write a balanced half equation for the reaction at the negative electrode.

_____

(1)

(iii) Suggest a suitable electrolyte for the electrolysis.

_____

(1)

(c) Copper metal is used in electrical appliances.

Describe the bonding in a metal, and explain why metals conduct electricity.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) Soil near copper mines is often contaminated with low percentages of copper compounds.

Phytomining is a new way to extract copper compounds from soil.

Describe how copper compounds are extracted by phytomining.

_____

_____

_____

_____

_____

_____

(3)

(e) A compound in a copper ore has the following percentage composition by mass:

55.6% copper, 16.4% iron, 28.0% sulfur.

Calculate the empirical formula of the compound.

Relative atomic masses (A_r): S = 32; Fe = 56; Cu = 63.5

You must show all of your working.

_____

_____

_____

_____

_____

_____

_____

_____

Empirical formula = _____

(4)

(Total 16 marks)

Q17.

This question is about metals.

(a) Which unreactive metal is found in the Earth as the metal itself?

Tick (✓) **one** box.

aluminium ☐

gold ☐

magnesium ☐

(1)

(b) Complete the sentence.

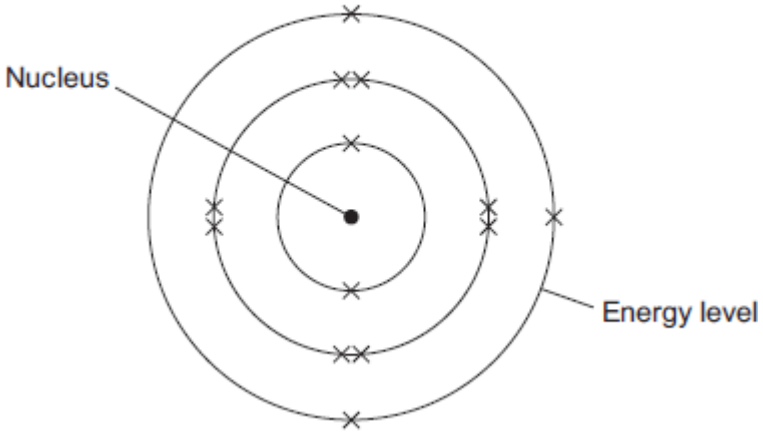
Aluminium is an element because aluminium is made of

only one type of _____ .

(1)

(c) **Figure 1** shows the electronic structure of an aluminium atom.

Figure 1



(i) Use the correct words from the box to complete the sentence.

electrons	**ions**	**protons**	**neutrons**	**shells**

The nucleus of an aluminium atom contains _____ and

_____ .

(2)

(ii) Complete the sentence.

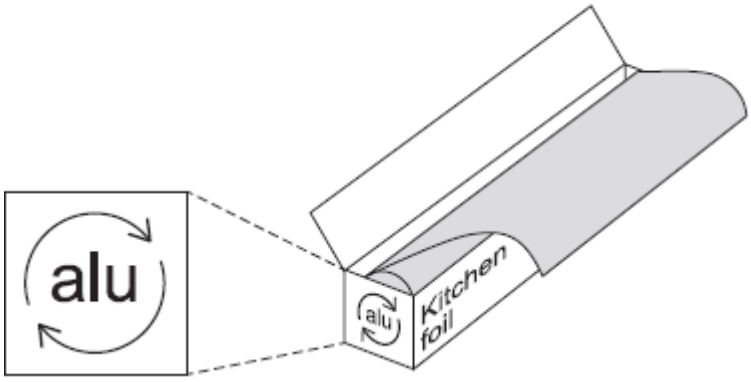
In the periodic table, aluminium is in Group _____ .

(1)

(d) Aluminium is used for kitchen foil.

Figure 2 shows a symbol on a box of kitchen foil.

Figure 2



The symbol means that aluminium can be recycled. It does not show the correct chemical symbol for aluminium.

(i) What is the correct chemical symbol for aluminium?

_____ .

(1)

(ii) Give **two** reasons why aluminium should be recycled.

_____

_____

_____

_____

(2)

(e) Aluminium has a low density, conducts electricity and is resistant to corrosion.

Which **one** of these properties makes aluminium suitable to use as kitchen foil? Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q18.

Copper is a transition metal.

(a) (i) Where is copper in the periodic table?

Tick (✓) **one** box.

in the central block ☐

in Group 1 ☐

in the noble gas group ☐

(1)

(ii) What is a property of copper?

Tick (✓) **one** box.

breaks easily ☐

conducts electricity ☐

does not conduct heat ☐

(1)

(b) Copper ores are quarried by digging large holes in the ground, as shown in **Figure 1**.

Figure 1

© photllurg/iStock/Thinkstock

Give **two** reasons why quarrying is bad for the environment.

(2)

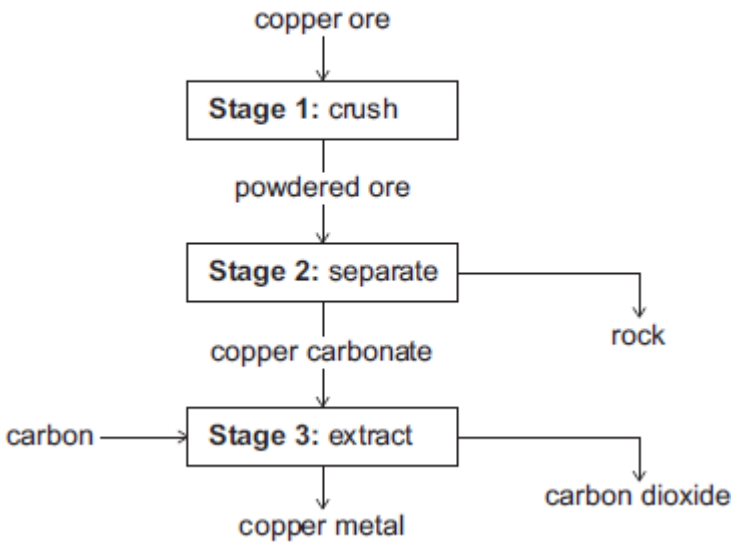
(c) Some copper ores contain only 2% copper.

Most of the ore is rock that is not needed.

In one ore, the main compound is copper carbonate ($CuCO_3$).

Figure 2 shows the stages used in the extraction of copper from this ore.

Figure 2



(i) Why is **Stage 2** important?

(1)

(ii) The equation for the reaction in **Stage 3** is:

$$2\ CuCO_3 + C \longrightarrow 2\ Cu + 3\ CO_2$$

From the symbol equation, a company calculated that 247 tonnes of copper carbonate are needed to produce 127 tonnes of copper and 132 tonnes of carbon dioxide are released.

Calculate the mass of carbon needed to make 127 tonnes of copper.

copper carbonate	+	carbon	⟶	copper	+	carbon dioxide
247 tonnes		..... tonnes		127 tonnes		132 tonnes

_____

(2)

(iii) Suggest **one** reason why it is important for the company to calculate the mass of reactants in **Stage 3**.

_____

_____

(1)

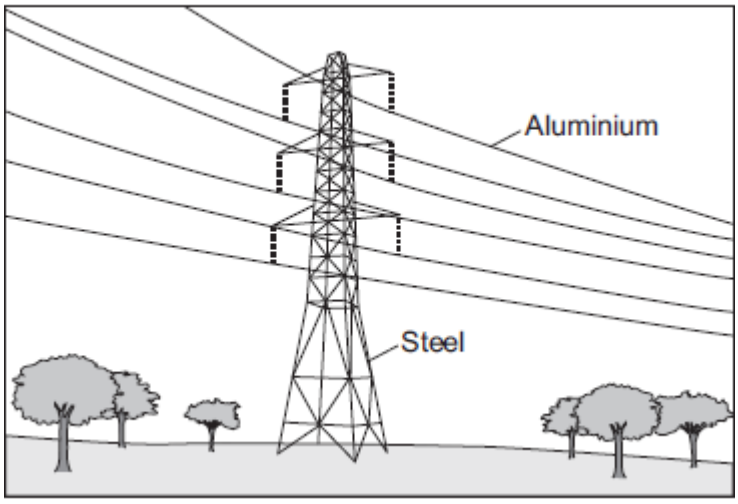
(Total 8 marks)

Q19.

This question is about metals.

Figure 1 shows the metals used to make pylons and the wires of overhead cables.

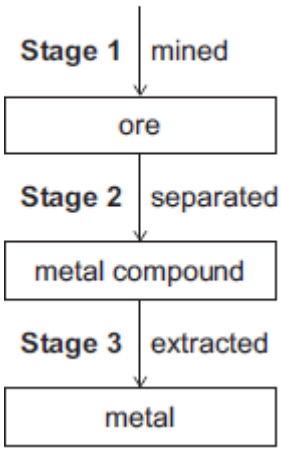
Figure 1



(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

Figure 2



Explain why **Stage 2** needs to be done.

_____

_____

_____

_____

(2)

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

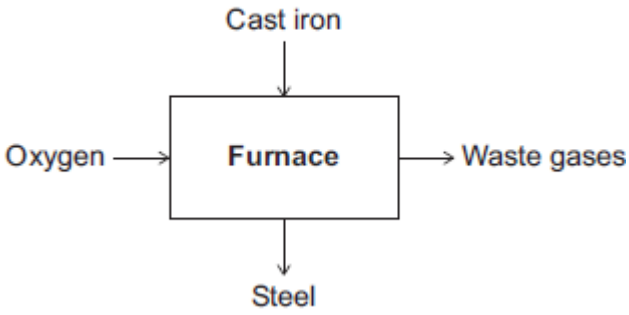
_____

_____

(1)

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

Figure 3



Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

_____

_____

_____

_____

(2)

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

_____

_____

(1)

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

_____

_____

_____

_____

(2)

(iii) Copper can be extracted from solutions of copper salts by adding iron.

Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q20.

This question is about salts.

(a) Salt (sodium chloride) is added to many types of food.

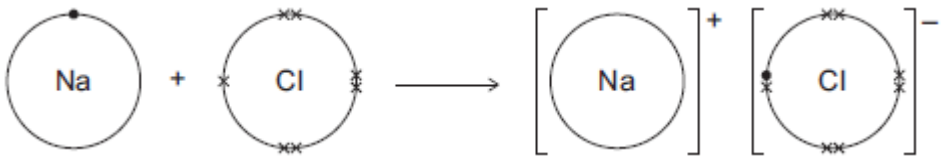
Sodium chloride is produced by reacting sodium with chlorine.

sodium + chlorine ⟶ sodium chloride

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

The dots (•) and crosses (×) represent electrons.

Only the outer electrons are shown.



Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

_____

_____

_____

_____

_____

_____

(3)

(b) Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

(i) Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

Tick (✓) **one** box.

Have no overall electric charge	☐
Have high boiling points	☐
Have giant covalent structures	☐

(1)

(ii) Which one of the following questions cannot be answered by science alone?

Tick (✓) **one** box.

How much sodium chloride is in food?	☐
What harm does a lack of iodine do?	☐
Should iodine be added to salt in food?	☐

Give **one** reason why this question cannot be answered by science alone.

_____

_____

(2)

(c) A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

(i) Name the acid used.

_____

(1)

(ii) Use the correct answer from the box to complete the sentence.

an acid	**an alkali**	**a salt**

Ammonia solution (ammonium hydroxide) is _____ .

(1)

(iii) The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

The solution added is an _____ .

(1)

(d) Farmers buy solid ammonium nitrate in poly(ethene) sacks.

(i) How is solid ammonium nitrate made from a solution of ammonium nitrate?

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

(1)

(ii) Why do farmers use ammonium nitrate on their fields?

_____

_____

(1)

(iii) The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

_____

_____

(1)

(Total 12 marks)

Q21.

This question is about metals and alloys.

(a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

_____

(4)

(b) Describe how the structure of an alloy is different from the structure of a pure metal.

(2)

(c) Alloys are used to make dental braces and coins.

(i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

(1)

(ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

(1)

(iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

Aluminium is manufactured by the electrolysis of a molten mixture of cryolite and

(1)

(iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

_____

_____

(1)

(d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

_____

_____

_____

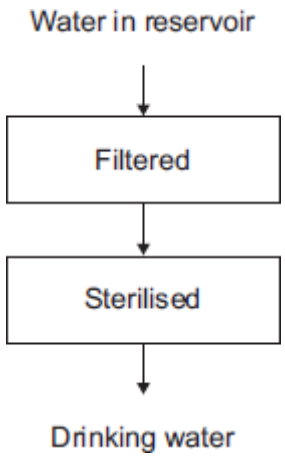
(1)

(Total 11 marks)

Q22.

This question is about drinking water.

(a) The flow diagram below shows how water is made suitable for drinking.



(i) What is removed when the water is filtered?

Tick (✓) **one** box.

Gases ☐

Liquids ☐

Solids ☐

(1)

(ii) What is used to sterilise the water?

Tick (✓) **one** box.

Carbon ☐

Chlorine ☐

Sodium chloride ☐

(1)

(iii) Why is the water sterilised?

_____

_____

(1)

(b) Water can be purified by distillation.

Drinking water is **not** usually purified by distillation because distillation is expensive.

Complete the sentence.

Distillation is expensive because it requires a lot of

_____

(1)

(c) Why do some water companies add fluoride to drinking water?

_____

_____

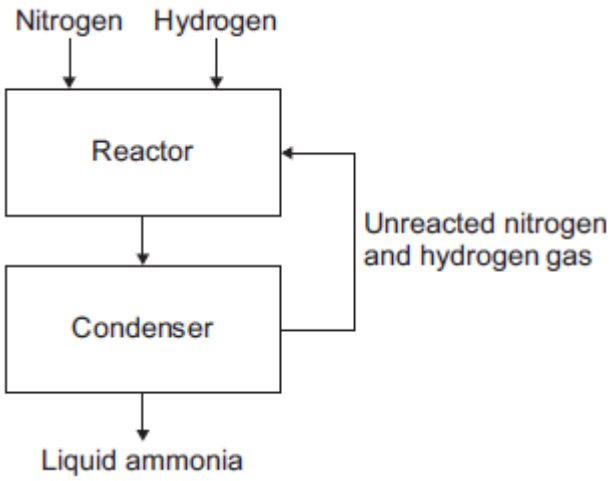
(1)

(Total 5 marks)

Q23.

A flow diagram of the Haber process is shown below.

The Haber process produces ammonia from nitrogen and hydrogen.



(a) Use the correct answer from the box to complete the sentence.

air	limestone	natural gas

Hydrogen is obtained from _____ .

(1)

(b) In the reactor, nitrogen and hydrogen at a high pressure are heated and passed over a catalyst.

(i) Use the correct answer from the box to complete the sentence.

25	100	450

The temperature in the reactor is _____ °C

(1)

(ii) Use the correct answer from the box to complete the sentence.

copper	iron	nickel

The catalyst used in the reactor is _____ .

(1)

(iii) How does a catalyst speed up a reaction?

Tick (✓) **one** box.

The catalyst lowers the activation energy. ☐

The catalyst gives the reactants extra energy. ☐

The catalyst increases the pressure in the reactor. ☐

(1)

(c) A mixture of gases leaves the reactor.

The mixture contains ammonia, nitrogen and hydrogen.

Describe what happens to this mixture of gases in the condenser.

Use the flow diagram to help you.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q24.

This question is about reversible reactions and chemical equilibrium.

(a) Reversible reactions can reach equilibrium in a closed system.

(i) What is meant by a closed system?

_____

_____

(1)

(ii) Explain why, when a reversible reaction reaches equilibrium, the reaction appears to have stopped.

_____

_____

_____

_____

(2)

(b) In the Haber process, the reaction of nitrogen with hydrogen to produce ammonia is reversible.

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

(i) Name a natural resource from which hydrogen is produced.

_____

(1)

(ii) The Haber process uses a catalyst to speed up the reaction.

Explain how a catalyst speeds up a reaction.

_____

_____

_____

_____

(2)

(iii) What happens to the amount of ammonia produced at equilibrium if the pressure is increased?

Give a reason for your answer.

_____

_____

_____

_____

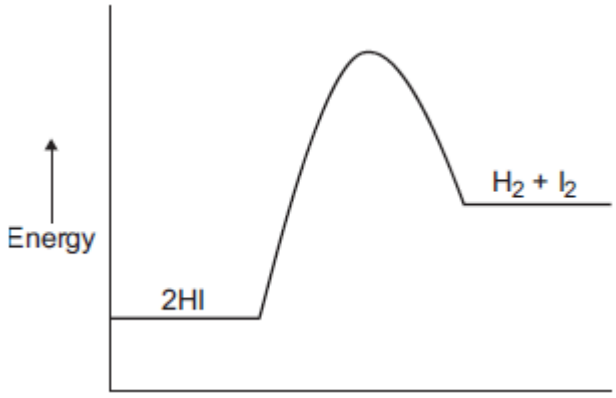
(2)

(c) The decomposition of hydrogen iodide into hydrogen and iodine is reversible.

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

The forward reaction is endothermic.

The energy level diagram shown below is for the forward reaction.



(i) Draw an arrow to show the activation energy on the diagram.

(1)

(ii) How does the diagram show that the reaction is endothermic?

_____

_____

(1)

(iii) Suggest what effect, if any, increasing the temperature will have on the amount of hydrogen iodide at equilibrium.

Give a reason for your answer.

_____

_____

_____

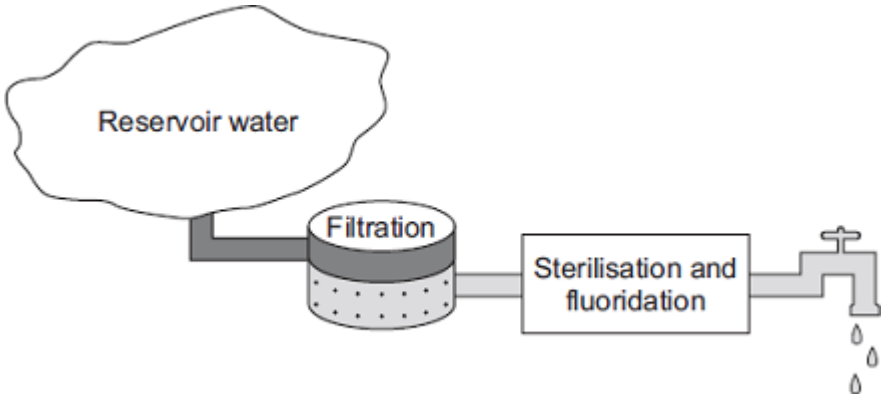
_____

(2)

(Total 12 marks)

Q25.

The diagram shows three stages in the treatment of reservoir water.



(a) (i) What is separated from the reservoir water during filtration?

Tick (✔) **one** box.

Bacteria ☐

Dissolved nitrates ☐

Solids ☐

(1)

(ii) What is added to sterilise the water?

Tick (✔) **one** box.

Calcium ☐

Chlorine ☐

Magnesium ☐

(1)

(iii) State **one** advantage of adding fluoride to drinking water.

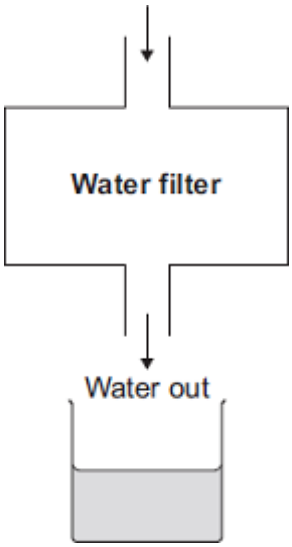
_____

_____

(1)

(b) The diagram shows a water filter used in the home.

Water in



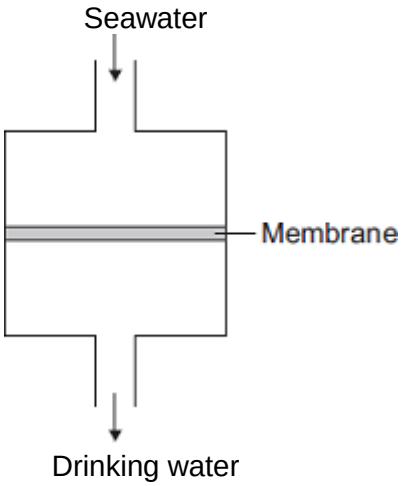
A student collected a sample of water from the filter.

The student could show that the filtered water contains dissolved salts without using a chemical test.

Describe how.

(2)

(c) Seawater is forced through a membrane to make drinking water.



Suggest why water molecules can pass through the membrane, but sodium ions and chloride ions cannot.

(1)

(Total 6 marks)

Q26.

Iron will rust in damp air.

(a) Iron reacts with water and oxygen to produce rust.

(i) As iron rusts there is a colour change.

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

During the reaction iron changes from grey to

blue **brown** **green**

(1)

(ii) Rust is hydrated iron oxide.

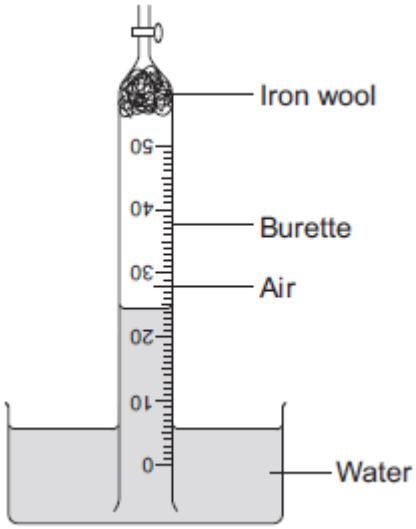
Write a word equation for the reaction of iron with oxygen and water.

_____

(1)

(b) A student set up the apparatus shown in **Figure 1**.

Figure 1



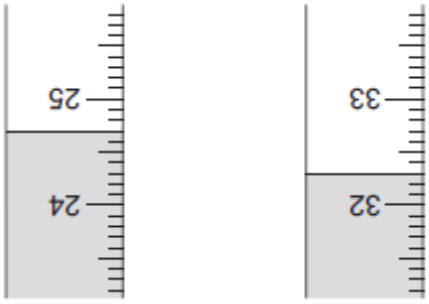
The student left the apparatus for a few days.

The water level in the burette slowly went up and then stopped rising.

Figure 2 shows the water level in the burette at the start of the experiment and after a few days.

Figure 2

At start **After a few days**



(i) Complete the table below to show the reading on the burette after a few days.

Burette reading at start	24.7 cm^3
Burette reading after a few days	_____ cm^3

(1)

(ii) Calculate the volume of oxygen used up in the reaction.

_____

Volume = _____ cm^3

(1)

(iii) The percentage of air that is oxygen can be calculated using the equation:

$$\text{percentage of air that is oxygen} = \frac{\text{volume of oxygen used up}}{\text{volume of air at start}} \times 100$$

The student **cannot** use his results to calculate the correct percentage of air that is oxygen.

Explain why.

_____

_____

_____

_____

_____

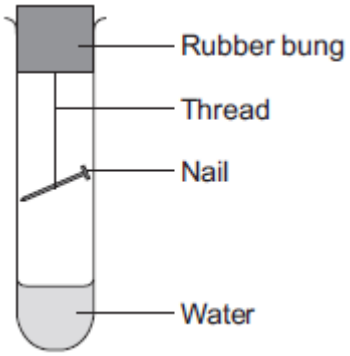
(2)

(c) A student investigated the rusting of an iron nail at different temperatures.

This is the method the student used:

- measure the mass of a nail
- set up apparatus as shown in **Figure 3**
- leave for 3 days
- measure the mass of the rusted nail.

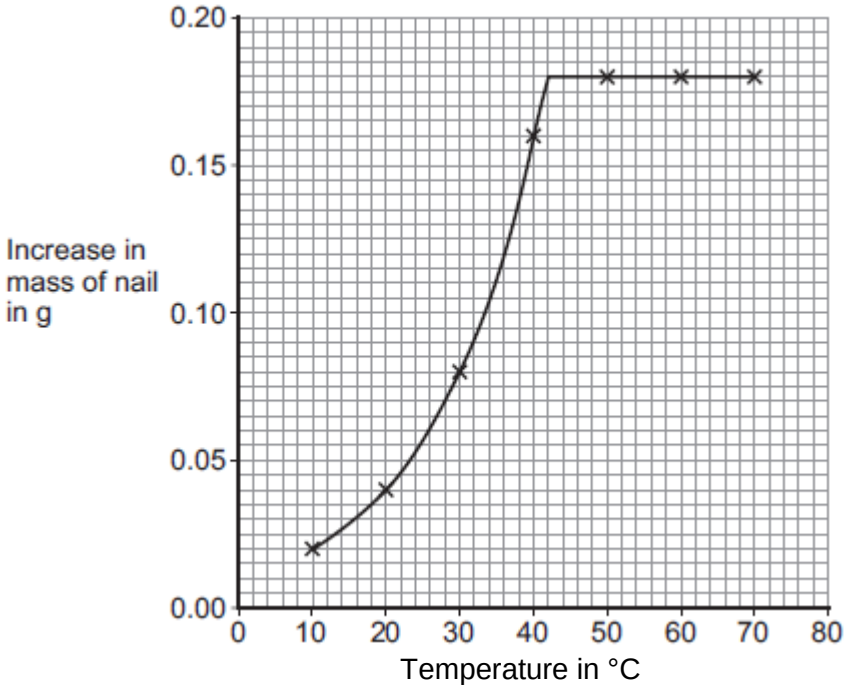
Figure 3



The student repeated the experiment at different temperatures using a new, identical, nail each time.

The student's results are shown on the graph in **Figure 4**.

Figure 4



(i) Why does the mass of the nail increase when it rusts?

_____

_____

(1)

(ii) Use the graph to describe the relationship between the temperature and the increase in mass of the nail.

_____

_____

_____

_____

_____

(3)

(iii) The increase in mass of the nail after 3 days is a measure of the rate of rusting.

The student's graph does **not** correctly show how increasing the temperature above 42 °C changes the rate of rusting.

How could the experiment be changed to show the effect of temperatures above 42 °C on the rate of rusting?

Give a reason for your answer.

_____

_____

_____

_____

_____

_____

(2)

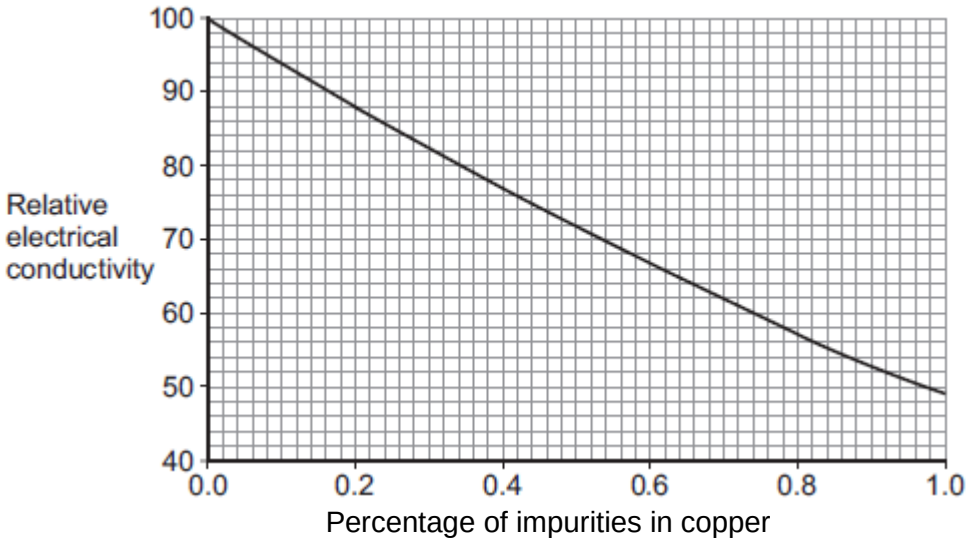
(Total 12 marks)

Q27.

This question is about copper.

(a) Most of the copper extracted is used in electric circuits.

The figure below shows how impurities change the electrical conductivity of copper.



Copper extracted by smelting is about 99% pure.

The 99% pure copper produced by smelting is purified to 99.9999% pure copper by electrolysis.

Use values from the graph to explain why copper is purified to 99.9999%.

(2)

(b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Read the information in the box.

Copper extraction

World demand for copper for the year 2011 was about 20 million tonnes.

World reserves of copper are estimated to be 700 million tonnes.

Most of the copper used is obtained from copper ores, which are mined.

The copper ore chalcopyrite is heated in a furnace to produce copper sulfide, CuS

The furnace is heated by burning fossil fuels.

Air is then blown through the hot copper sulfide, to produce copper and sulfur dioxide.

$$CuS + O_2 \rightarrow Cu + SO_2$$

A scientist made the statement: 'Copper should be recycled'.

Use the information in the box and your own knowledge and understanding to justify the scientist's statement.

Extra space

(6)

(c) Phytomining is used to obtain copper from land that contains very low percentages of copper compounds.

Describe how copper compounds are obtained by phytomining.

(3)

(Total 11 marks)

Q28.

Where copper ore has been mined there are areas of land that contain very low percentages of copper compounds.

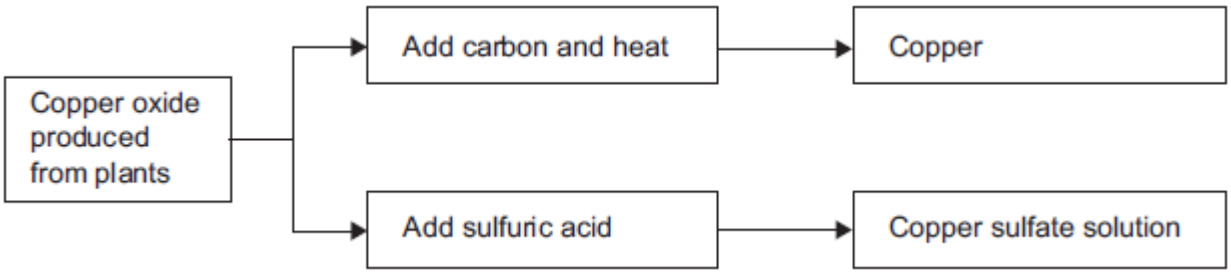
One way to extract the copper is to grow plants on the land.

The plants absorb copper compounds through their roots.

The plants are burned to produce copper oxide.

The copper oxide produced from plants can be reacted to produce copper or copper sulfate solution, as shown in **Figure 1**.

Figure 1



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

(i) Copper ores contain enough copper to make extraction of the metal

carbon neutral.

economical.

reversible.

(1)

(ii) Using plants to extract metals is called

photosynthesis.

phytomining.

polymerisation.

(1)

(iii) Copper oxide reacts with carbon to produce copper and

carbon dioxide.

oxygen.

sulfur dioxide.

(1)

(b) Copper is produced from copper sulfate solution by displacement using iron or by electrolysis.

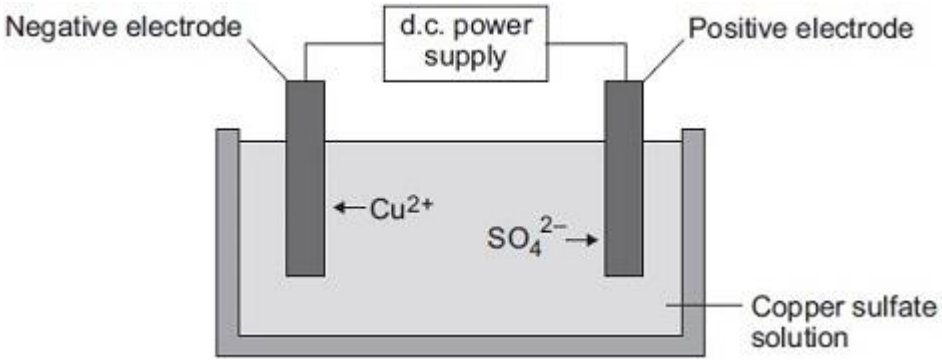
(i) Complete the word equation.

copper sulfate + iron ⟶ _____ + _____

(2)

(ii) **Figure 2** shows the electrolysis of copper sulfate solution.

Figure 2



Why do copper ions go to the negative electrode?

_____

_____

(1)

(c) Suggest **two** reasons why copper should **not** be disposed of in landfill sites.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q29.

Where copper ore has been mined there are areas of land that contain very low percentages of copper compounds.

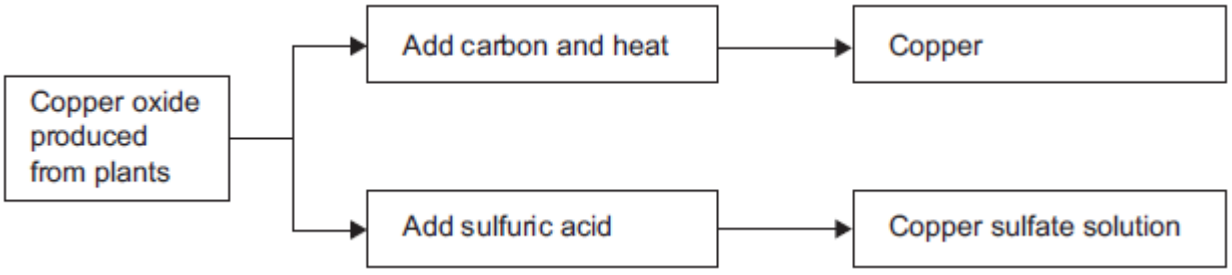
One way to extract the copper is to grow plants on the land.

The plants absorb copper compounds through their roots.

The plants are burned to produce copper oxide.

The copper oxide produced from plants can be reacted to produce copper or copper sulfate solution, as shown in **Figure 1**.

Figure 1



(a) (i) Complete the sentence.

Using plants to extract metals is called _____ .

(1)

(ii) Suggest **two** reasons why copper from these areas of land is **not** extracted by smelting.

_____

_____

_____

_____

_____

(2)

(iii) Complete and balance the chemical equation for the reaction of copper oxide with carbon.

____CuO + C ⟶ _____ + CO_2

(2)

(b) Copper is produced from copper sulfate solution by displacement using scrap iron or by electrolysis.

(i) Use the Chemistry Data Sheet to help you to answer this question.

Give **two** reasons why scrap iron is used to displace copper.

_____

_____

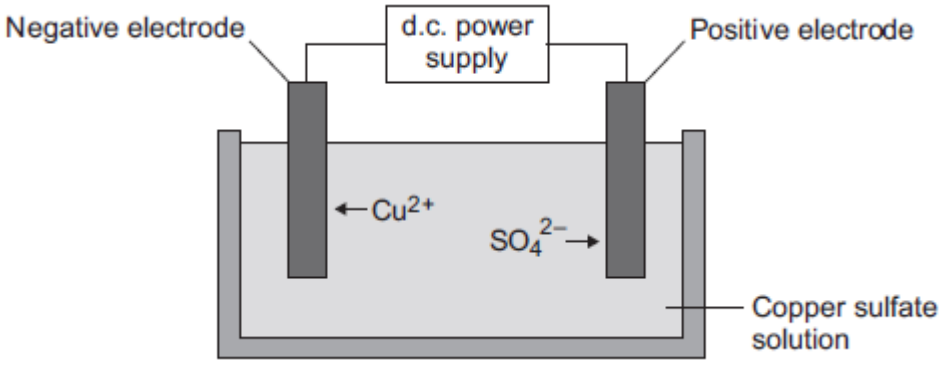
_____

_____

(2)

(ii) **Figure 2** shows the electrolysis of copper sulfate solution.

Figure 2



Describe what happens to the copper ions during electrolysis.

_____

_____

_____

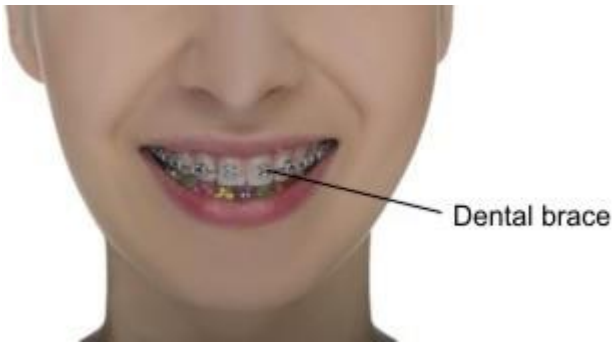
_____

(2)

(Total 9 marks)

Q30.

Dental braces are made from nitinol wires. Nitinol is a mixture of metals.



/iStock/Thinkstock © Zametalov/iStock/Thinkstock

(a) Nitinol can return to its original shape after being deformed.

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

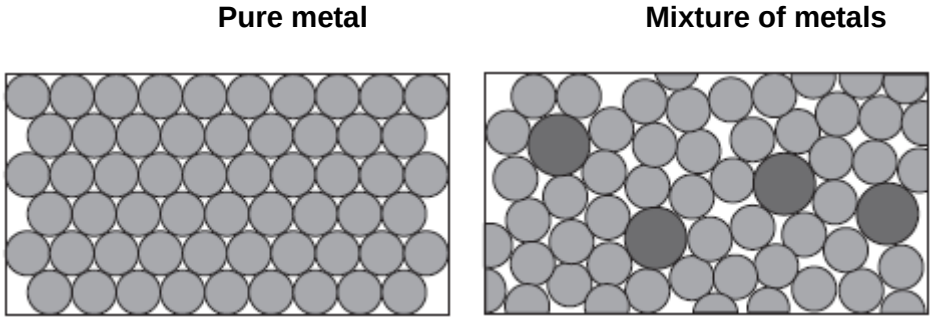
Nitinol is a shape memory

alloy.
catalyst.
polymer.

(1)

(b) **Figure 1** shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 1



The mixture of metals is harder than the pure metal.

Use **Figure 1** to explain why.

_____

_____

_____

_____

(2)

(c) Gold and stainless steel are also used for dental braces.

Suggest **two** factors to consider when choosing which metal to use for dental braces.

_____

_____

_____

_____

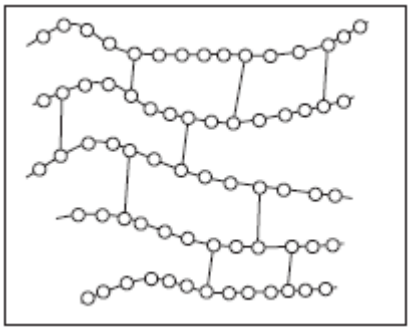
(2)

(d) A thermosetting polymer is used to hold dental braces on the teeth.

Figure 2 shows the structure of a thermosetting polymer.

Figure 2

Thermosetting polymer



How can you tell from **Figure 2** that the polymer is thermosetting?

_____

_____

(1)

(Total 6 marks)

Q31.

Water in Britain is taken from reservoirs to use as drinking water.

(a) What are the **two** main steps used to treat water from reservoirs?

Give **one** reason for each step.

(4)

(b) Some people use water filters to treat water before drinking it.

(i) Water filters remove hardness from hard water.

What is in water filters that removes hardness from water?

(1)

(ii) Suggest why water filters used in the home contain particles of silver.

(1)

(c) Pure water can be produced by distillation.

Why is distillation **not** usually an economic method of treating water for drinking?

_____

_____

(1)

(d) Drinking hard water has health benefits.

State **one** health benefit of drinking hard water.

_____

_____

(1)

(Total 8 marks)

Q32.

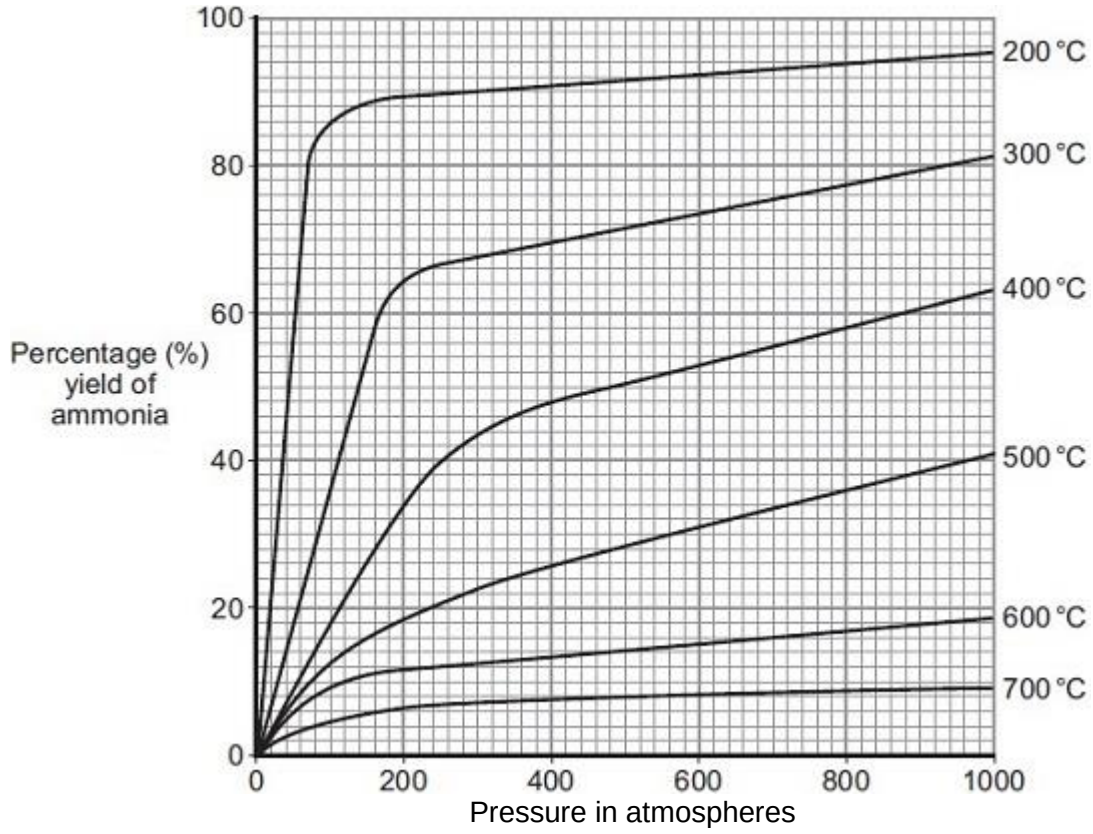
In 1909 Fritz Haber invented a process to produce ammonia from nitrogen and hydrogen.

(a) Complete and balance the chemical equation for the production of ammonia from nitrogen and hydrogen.

$$N_2 + 3\ H_2 \rightleftharpoons \_\_\_\_\_$$

(2)

(b) The figure below shows how the equilibrium yield of ammonia changes with pressure at different temperatures.



(i) Use the information in given in the figure to complete the sentence.

The temperature on the graph that gives the highest yield of ammonia is

_____ °C.

(1)

(ii) The temperature used in the Haber process for the production of ammonia is 450 °C.

Why is a temperature much lower than 450 °C **not** used for the Haber process?

_____

_____

(1)

(iii) Use the information in the figure to answer this question.

Draw a ring around the pressure that gives the highest yield of ammonia.

100 **200** **300** **400**

(1)

(iv) The pressure used in the Haber process for the production of ammonia is 200 atmospheres.

Why is a pressure lower than 200 atmospheres **not** used for the Haber process?

_____

_____

(1)

(c) Explain how ammonia is separated from unreacted nitrogen and hydrogen in the Haber process.

_____

_____

_____

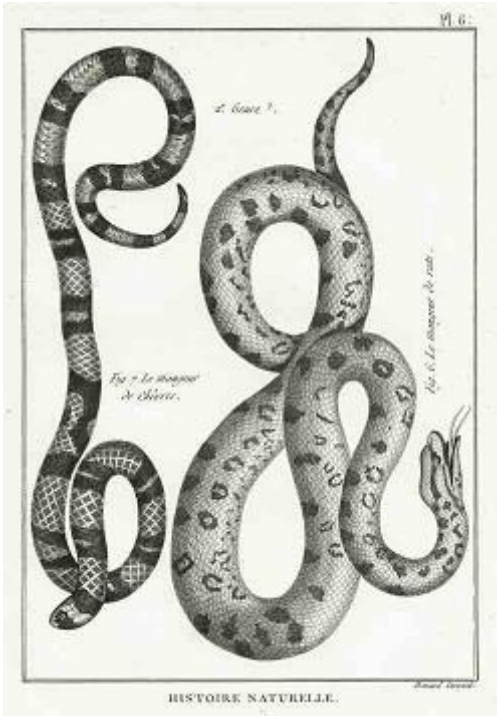
_____

(2)

(Total 8 marks)

Q33.

Printed pictures can be made using etchings.



An etching can be made when a sheet of brass reacts with iron chloride solution.

(a) Brass is a mixture of two metals, copper and zinc.

(i) A mixture of two metals is called _____ .

(1)

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

Copper and zinc atoms are different sizes.

This makes brass | harder / more flexible / softer | than the pure metals.

(1)

(b) Iron chloride has the formula $FeCl_3$

Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

(i) Calculate the relative formula mass (M_r) of iron chloride ($FeCl_3$).

_____

_____

_____

Relative formula mass (M_r) of iron chloride = _____

(2)

(ii) Calculate the percentage of iron in iron chloride ($FeCl_3$).

_____

_____

_____

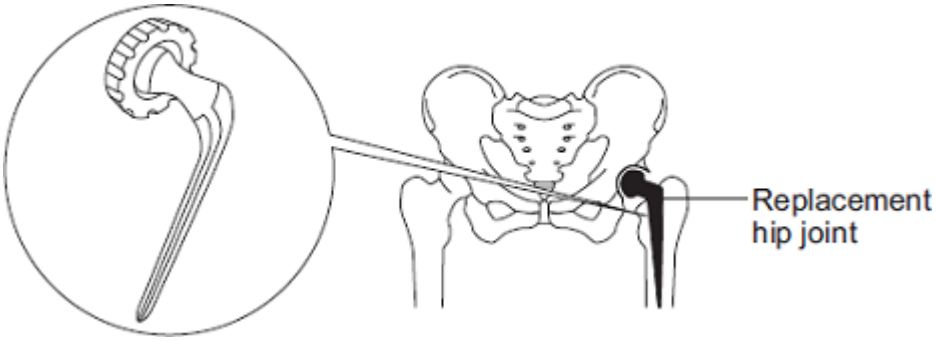
Percentage of iron in iron chloride = _____%

(2)

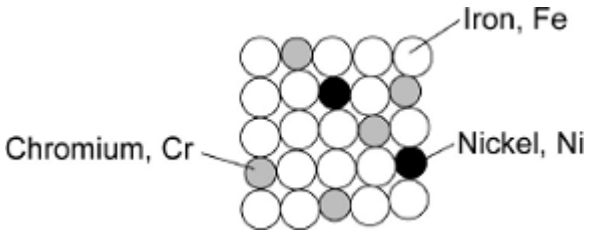
(Total 6 marks)

Q34.

The hip joint sometimes has to be replaced.
Early replacement hip 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.



Paticle diagram of stainless steal

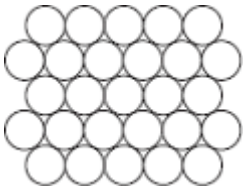
(a) Use the diagram to complete the percentages of metals in this stainless steel.

The first one has been done for you.

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

(2)

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



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

_____

_____

(1)

(ii) Pure iron would **not** be suitable for a replacement hip joint.

Suggest why.

_____

_____

(1)

(iii) The three metals in stainless steel have different sized atoms.
Stainless steel is harder than pure iron.

Explain why.

_____

_____

_____

_____

(2)

(Total 6 marks)