

Using Resources part 2

Q1.

- (a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

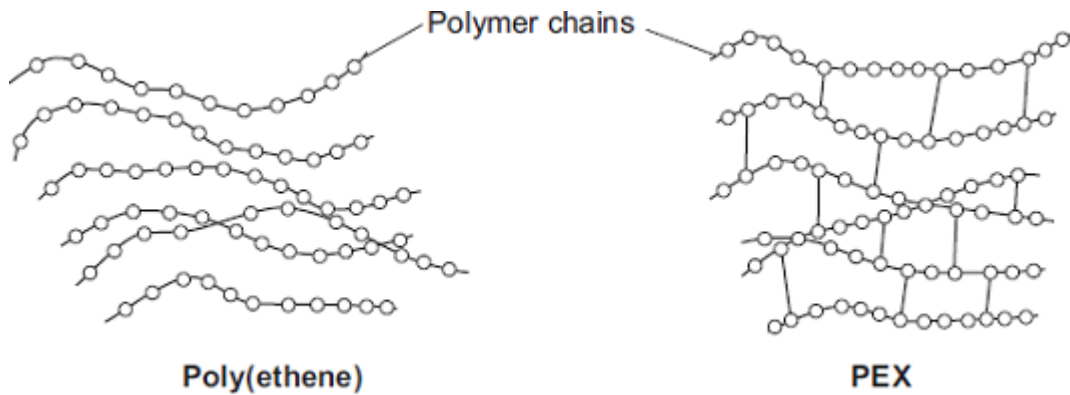
- (i) Describe how ethene forms poly(ethene).

(2)

- (ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

(1)

- (iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) is a thermoplastic that softens easily when heated. Suggest and explain how the structure of PEX changes this property.

(3)

- (b) Copper is a suitable material to use for hot water pipes.



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

fertilisers	insecticides	pesticides
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Ammonium salts contain nitrogen and are used by farmers as
 _____ to replace the nitrogen lost from the soil.

(1)

- (b) Ammonia is made by reacting nitrogen with hydrogen.

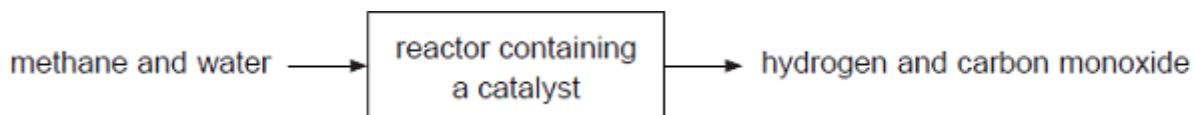
Which raw material provides nitrogen?

Draw a ring around your answer.

air **crude oil** **water**

(1)

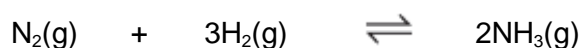
- (c) Methane and water react together to form hydrogen.



How does the catalyst help this reaction?

(1)

- (d) The reaction between nitrogen and hydrogen to make ammonia can be represented by this equation.



What is the meaning of this symbol \rightleftharpoons ?

Draw a ring around your answer.

endothermic reaction precipitation reaction reversible reaction

(1)

(e) A solution of ammonia in water is alkaline.

(i) Which **one** of these values could be the pH of a solution of ammonia?

Draw a ring around your answer.

4

7

10

(1)

(ii) Ammonium sulfate can be made by reacting ammonia solution with sulfuric acid.

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

**ammonium
sulfate**

hydrogen

sulfuric

water

During the reaction the hydrogen ions (H^+) from the acid react with hydroxide ions

(OH^-) from the alkali to make _____

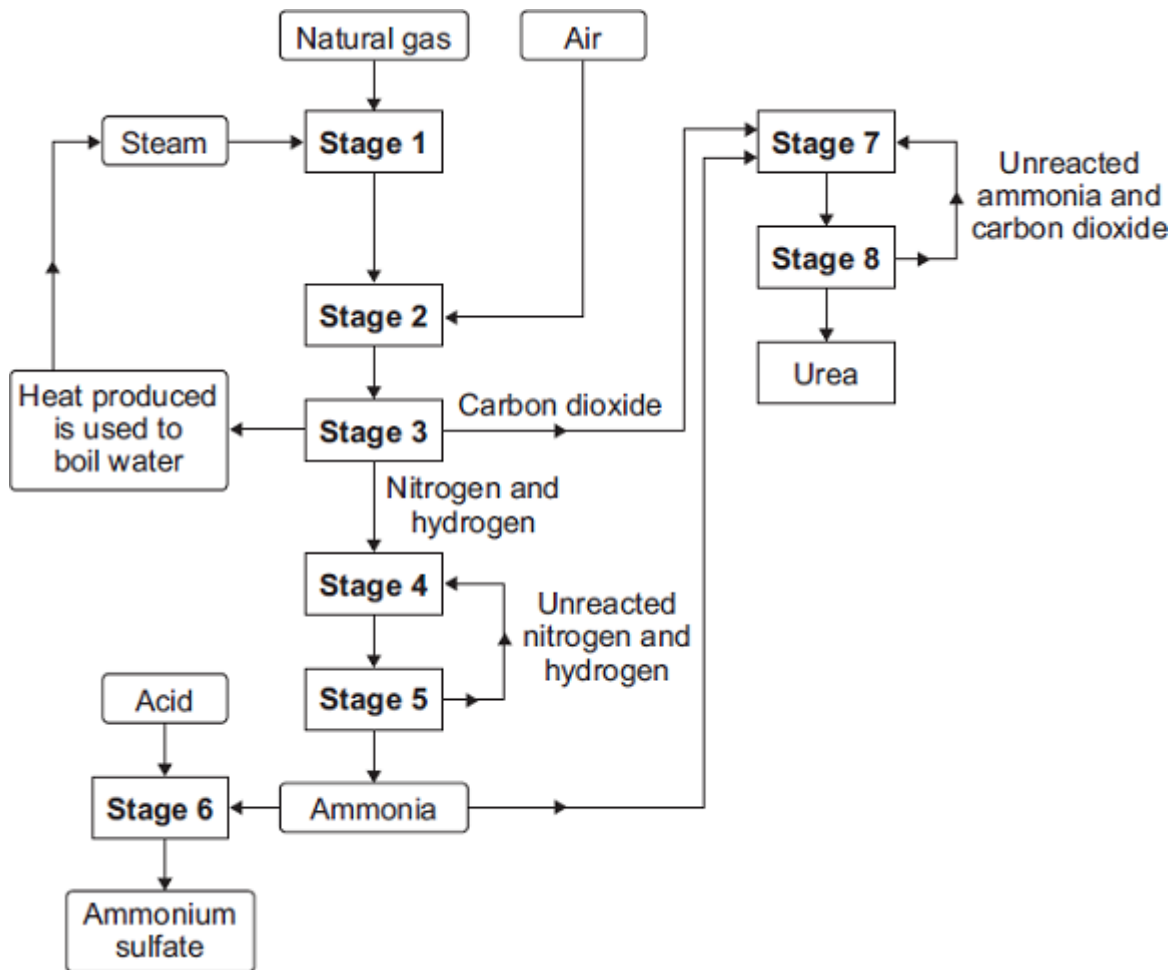
(1)

(Total 6 marks)

Q3.

Ammonium sulfate and urea are made from ammonia. These compounds are used by farmers.

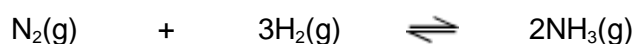
The flow diagram shows the stages to make ammonium sulfate and urea.



- (a) Give **two** examples from the flow diagram of the efficient use of energy and raw materials.

(2)

- (b) The equation for the reaction in Stage 4 is shown below.



The forward reaction is exothermic.

State **and** explain:

- (i) how a **decrease** in temperature would affect the yield of ammonia at equilibrium

(2)

(ii) how an **increase** in pressure would affect the yield of ammonia at equilibrium.

(2)

(c) The equation for the reaction in Stage 7 is shown below.



The table gives the relative formula masses (M_r) of the reactants and the products for this reaction.

Formula of reactant or product	Relative formula masses (M_r)
NH_3	17
CO_2	44
NH_2CONH_2	60
H_2O	18

Percentage atom economy can be calculated using:

$$\text{Percentage atom economy} = \frac{M_r \text{ of useful product}}{\text{total } M_r \text{ of all reactants added together}} \times 100\%$$

Calculate the percentage atom economy for the reaction in Stage 7.

Percentage atom economy = _____ %

(2)

(Total 8 marks)

Q4.

Poly(ethene) is a polymer with many uses.

- (a) Poly(ethene) is not biodegradable.

Give **one** problem caused by waste poly(ethene).

_____ (1)

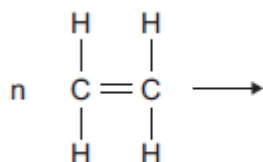
- (b) Many molecules of ethene are combined to make poly(ethene). Ethene is an alkene.

- (i) Complete the sentence about the colour change in the test for alkenes.

Alkenes turn bromine water from _____ to _____ .

(2)

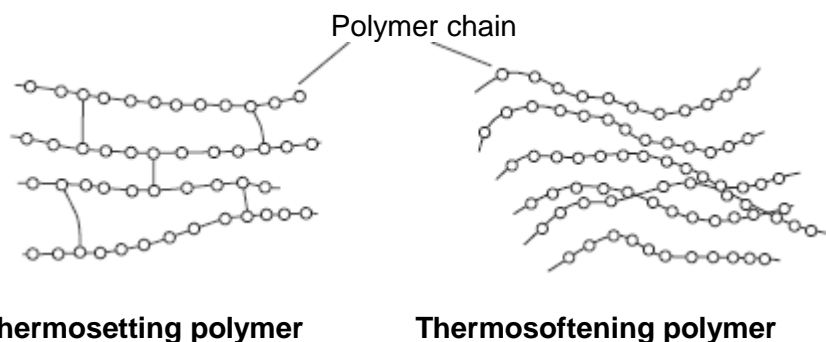
- (ii) Complete the equation below to show the formation of poly(ethene).



(3)

- (c) Poly(ethene) is a thermosoftening polymer that melts when heated.

The diagrams show a thermosetting polymer and a thermosoftening polymer.



The thermosetting polymer does **not** melt when heated.

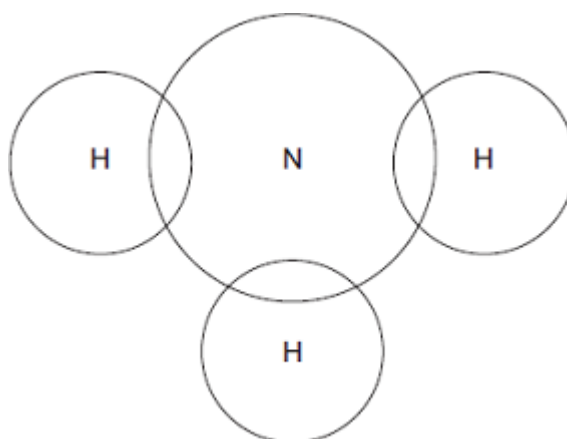
Use the diagrams and your knowledge of structure and bonding to explain why.

(3)
(Total 9 marks)

Q5.

- (a) Complete the dot and cross diagram to show the electrons in the outer energy levels of ammonia (NH_3).

You may use the periodic table to help you.



(2)

- (b) Ammonia can be used to make ammonium nitrate (NH_4NO_3).

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

Ammonium nitrate can be made by reacting ammonia with

ethanoic
hydrochloric
nitric

acid.

(1)

- (ii) State **one** use of ammonium nitrate.

(1)

- (iii) Calculate the relative formula mass (M_r) of ammonium nitrate (NH_4NO_3).

Relative atomic masses: H = 1; N = 14; O = 16.

(6)
(Total 14 marks)

Q6.

Most water contains dissolved compounds.

The concentrations of these dissolved compounds are higher in sea water than in drinking water.

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

Pure water can be obtained from sea water by

- | |
|-----------------|
| distillation. |
| filtration. |
| neutralisation. |

(1)

(ii) What is the boiling point of pure water? _____ °C

(1)

(b) A student wanted to find out how much solid was dissolved in sea water.

This is the method the student used:

- measure the mass of an empty evaporating basin
- measure 25 cm³ of sea water and pour it into the evaporating basin
- heat the evaporating basin gently until all of the water has evaporated
- measure the mass of the evaporating basin containing the solid residue.

(i) What piece of apparatus would be suitable for measuring 25 cm³ of sea water?

(1)

(ii) How could the student check that all of the water had evaporated?

(2)

(iii) The results the student obtained using 25 cm³ of sea water are:

mass of empty evaporating basin = 23.21 g

mass of evaporating basin and dry solid residue = 24.04 g

Calculate the mass of solid dissolved in 1000 cm³ of the sea water.

Mass dissolved in 1000 cm³ = _____ g

(2)

(c) In many countries chlorine is added to drinking water supplies.

Why is chlorine added to drinking water?

(1)

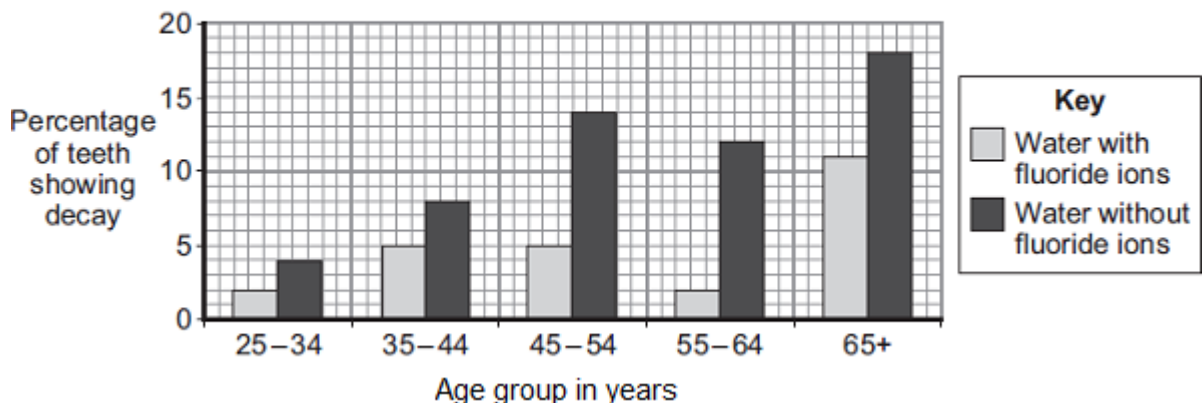
(d) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Compounds containing fluoride ions are added to some drinking water supplies.

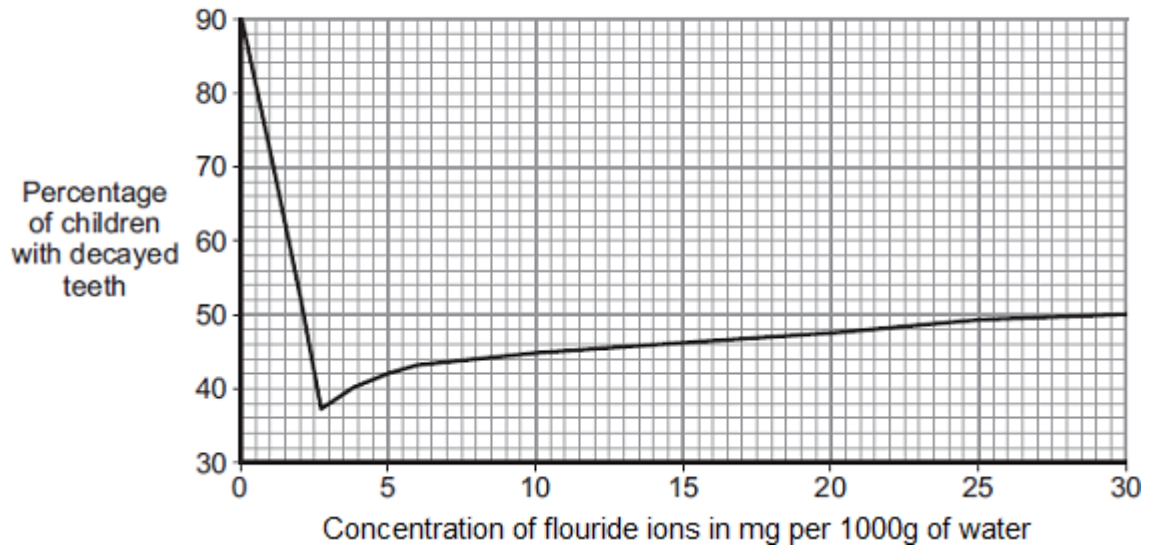
Many scientists have done research into the effects of fluoride ions in drinking water.

Graphs 1, 2 and 3 show some of the results obtained.

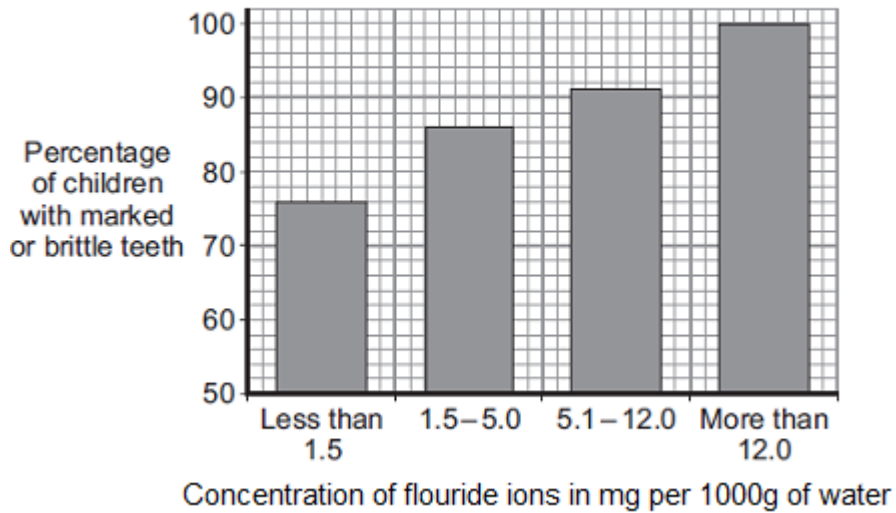
Graph 1



Graph 2



Graph 3



Evaluate the advantages and disadvantages of adding fluoride ions to drinking water.

You should support your answer with evidence from **all three** graphs.

(6)
(Total 14 marks)

Q7.

Metals are extracted from their ores.

Many copper ores contain only 2% of copper compounds.

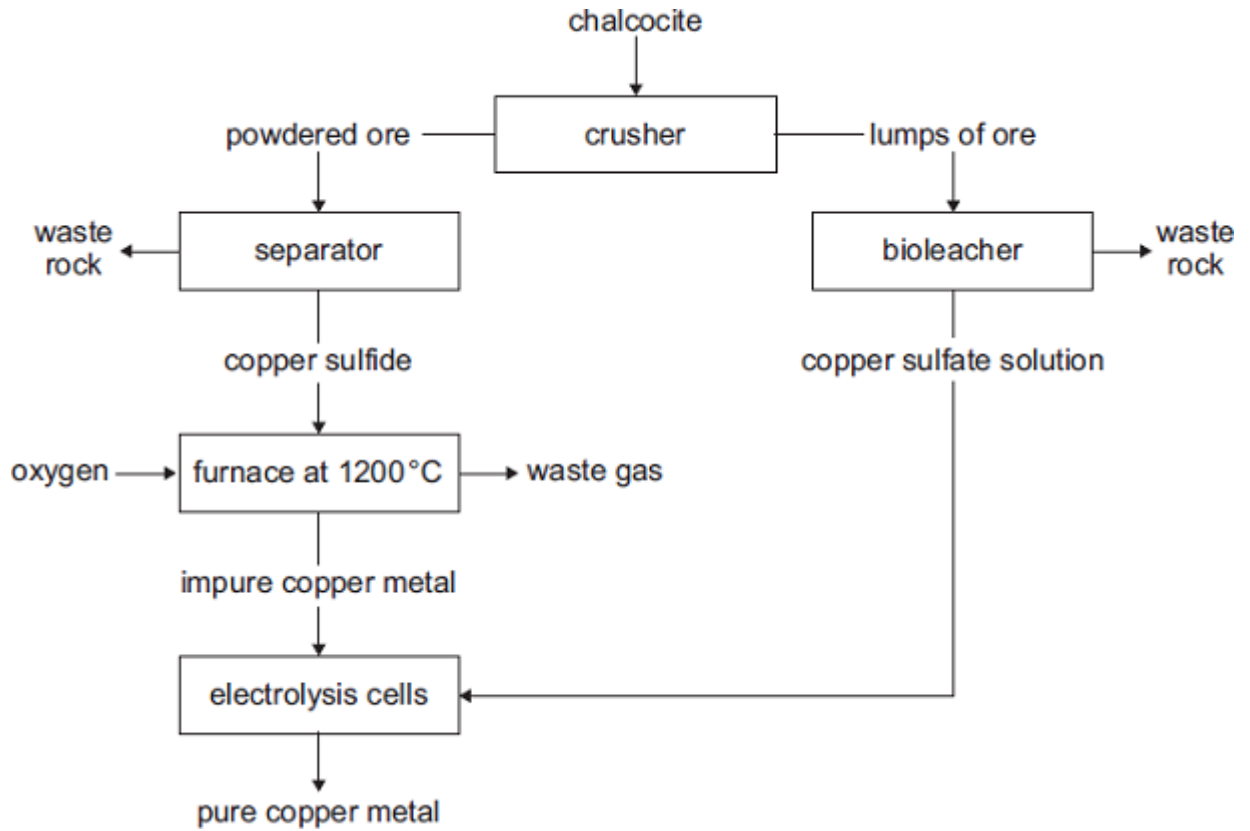
- (a) Copper is now extracted from ores containing a low percentage of copper compounds.

Suggest **two** reasons why.

(2)

- (b) Chalcocite, an ore of copper, contains copper sulfide.

The flow diagram shows how copper metal is extracted from chalcocite.



(i) Suggest **one** reason why it is difficult to dispose of the waste rock.

(1)

(ii) The reaction in the furnace could cause environmental pollution. Explain how.

(2)

(iii) The extraction of pure copper is expensive. Give **one** reason why.

(1)

(iv) Pure copper is produced by electrolysis of copper sulfate solution.

Which electrode do the copper ions move towards?
Give a reason for your answer.

(2)

- (v) Large areas of land are contaminated with copper compounds. Phytomining can be used to remove these copper compounds from the land.

What is used in phytomining to remove copper compounds from the land?

(1)

(Total 9 marks)

Q8.

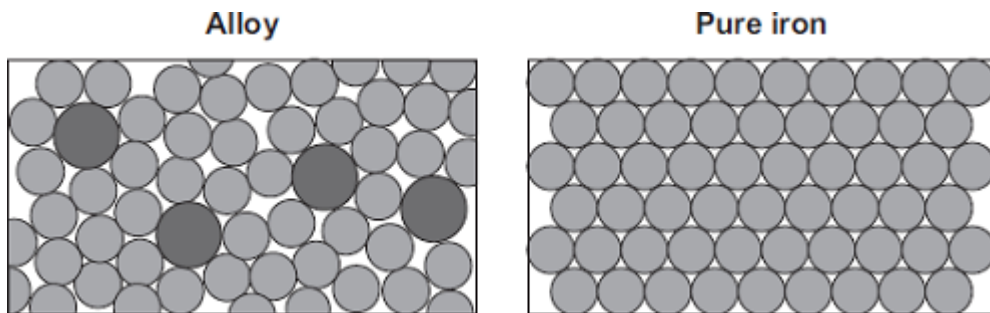
Oil rigs are used to drill for crude oil.



© Digital Vision/Photodisc

- (a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.



Use the diagrams to explain why the alloy is harder than pure iron.

(2)

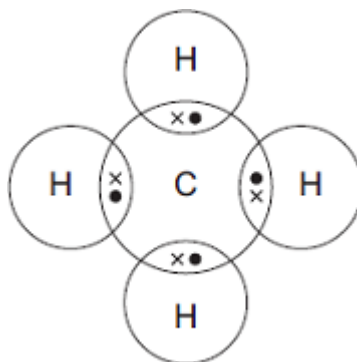
(b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2)

(c) Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.



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

Methane is

a compound.
an element.
a mixture.

(1)

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

The formula of methane is

C_4H_4
C_4H
CH_4

(1)

(iii) Name the type of bond between the carbon and hydrogen atoms in methane.

(1)

(d) Explain why methane is a gas at 20°C.

(2)
(Total 9 marks)

Q9.

Oil rigs are used to drill for crude oil.



© Digital Vision/Photodisc

(a) Drill heads are made from steel. Steel is an alloy.

Explain why alloys are harder than pure metals.

(3)

(b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

(4)

(c) Polymers are produced from crude oil.

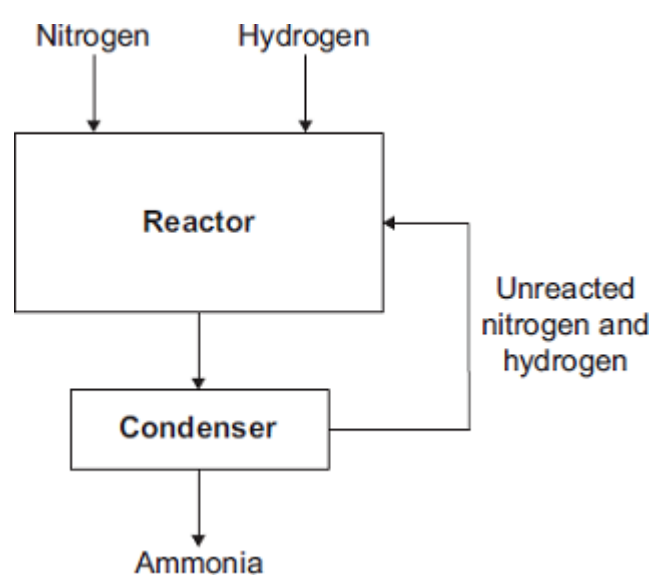
Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

(4)

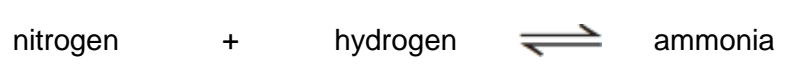
(Total 11 marks)

Q10.

The flow diagram shows the Haber process. In the Haber process ammonia is produced from nitrogen and hydrogen.



(a) The word equation for the production of ammonia is:



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

The symbol \rightleftharpoons in the word equation shows the reaction is

exothermic.
reversible.
slow.

(1)

(b) The reactor contains iron.

Complete the sentence.

The iron speeds up the reaction because it is a _____

(1)

(c) What happens to the unreacted nitrogen and hydrogen?

(1)

(d) The sentences describe how ammonia is produced in the Haber process.

The sentences are in the wrong order.

P Ammonia is separated as a liquid.

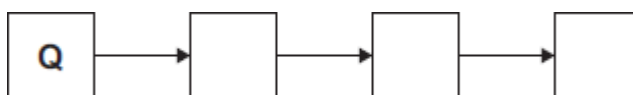
Q Nitrogen and hydrogen are mixed together.

R A mixture of gases enters the condenser.

S Nitrogen and hydrogen react to produce ammonia.

Complete the boxes below to show the correct order of the sentences.

The first box has been done for you.

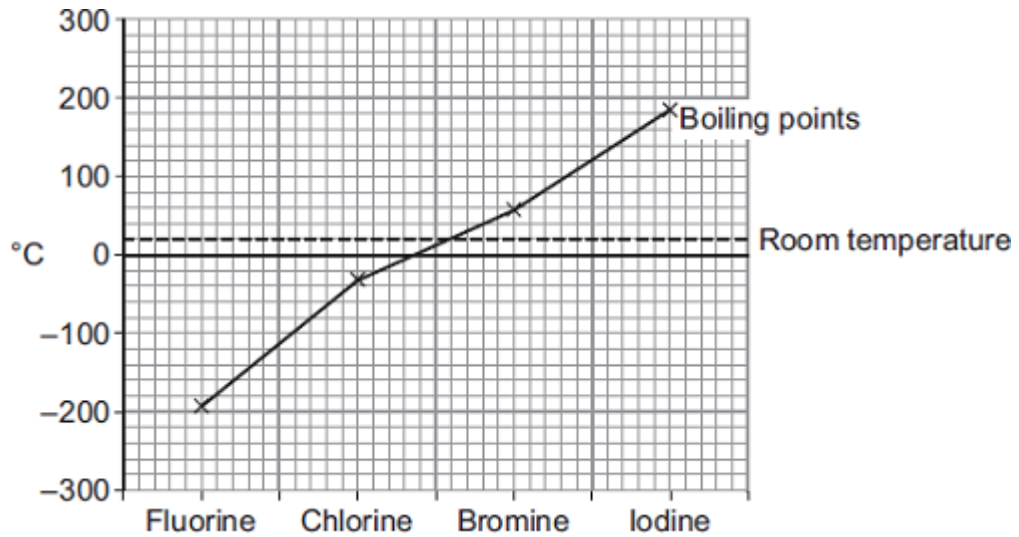


(2)

(Total 5 marks)

Q11.

The graph shows the boiling points of the halogens.



(a) Use the graph to help you answer these questions.

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

gas	liquid	solid
-----	--------	-------

At room temperature chlorine is a _____ .

(1)

(ii) Describe the trend in boiling point from fluorine to iodine.

(1)

(b) Chlorine reacts with metals to produce metal chlorides.

(i) When a chlorine atom forms a chloride ion it gains one electron.

What is the charge on a chloride ion?

(1)

(ii) Write a word equation for the reaction between sodium and chlorine.

(1)

(c) In the UK water companies add chlorine to tap water.

Why is chlorine added to tap water?

(1)

(d) Water companies add fluoride to tap water in some parts of the UK.

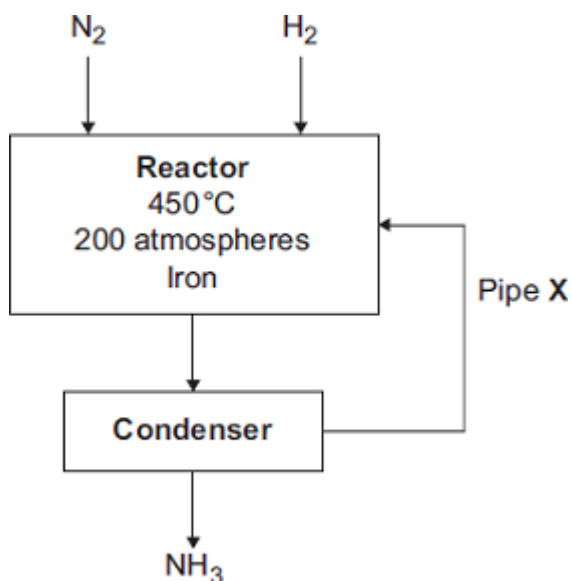
Fluoride is added to improve dental health.

Suggest **one** reason why some people are against adding fluoride to tap water.

(1)
(Total 6 marks)

Q12.

The flow diagram shows the Haber process. In the Haber process, ammonia (NH_3) is produced from nitrogen (N_2) and hydrogen (H_2).



(a) Which raw material is nitrogen obtained from?

(1)

(b) What is the purpose of Pipe X?

(2)

(c) Balance the chemical equation below for the production of ammonia.



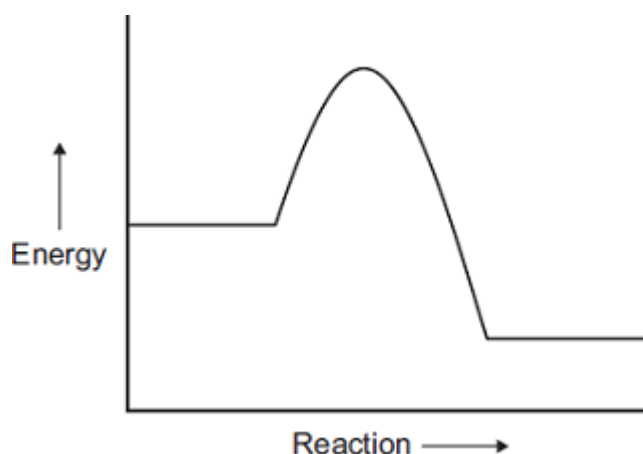
(1)

(d) A temperature of 450°C is used in the reactor.
The reaction of nitrogen with hydrogen is reversible.
The forward reaction is exothermic.

Explain why a temperature of 450°C is the optimum temperature for the Haber process.

(2)

- (e) An energy level diagram for the reaction between nitrogen and hydrogen is shown below.



- (i) How does the energy level diagram show this reaction is exothermic?

(1)

- (ii) In the Haber process iron is used as a catalyst.

Draw a line on the energy level diagram to show the effect of adding a catalyst.

(1)

(Total 8 marks)

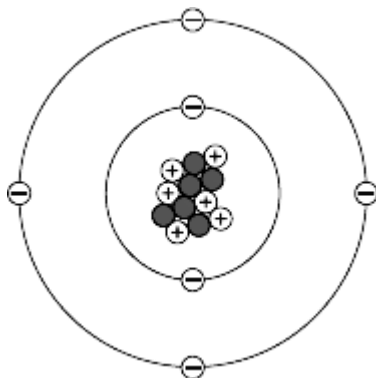
Q13.

The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

- (a) Diamond is a form of carbon. The diagram represents a carbon atom.



Complete the table to show the name and charge of each type of particle in the carbon atom.

Name of particle	Charge
proton	
neutron	0
	-1

(2)

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

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

Gold and carbon are

compounds.
elements.
mixtures.

(1)

(ii) Complete the sentence.

Gold and carbon have different properties because gold is a metal and carbon is a _____

(1)

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

Pure gold is not used to make the ring because pure gold is too

hard.
reactive.
soft.

The gold ring is made by mixing pure gold with other metals to form

a compound.
an atom.
an alloy.

- (d) The data in the table shows some information about the three metals in the gold ring.

Name of metal	Atomic number	Percentage (%) of metal
gold	79	
silver	47	16
copper	29	9

Draw **one** line from each question to its correct answer.

Question	Answer
What is the percentage of gold in this ring?	29
How many electrons are there in a copper atom?	61
How many neutrons are in an atom of silver with a mass number of 108?	75
	79

(3)
(Total 9 marks)

Q14.

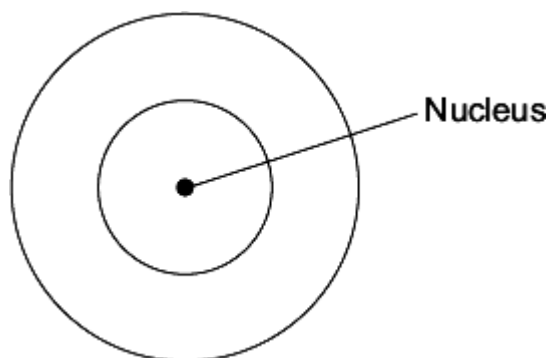
The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

- (a) Diamond is a form of carbon. A carbon atom has six electrons.

Draw the electronic structure of a carbon atom.



(1)

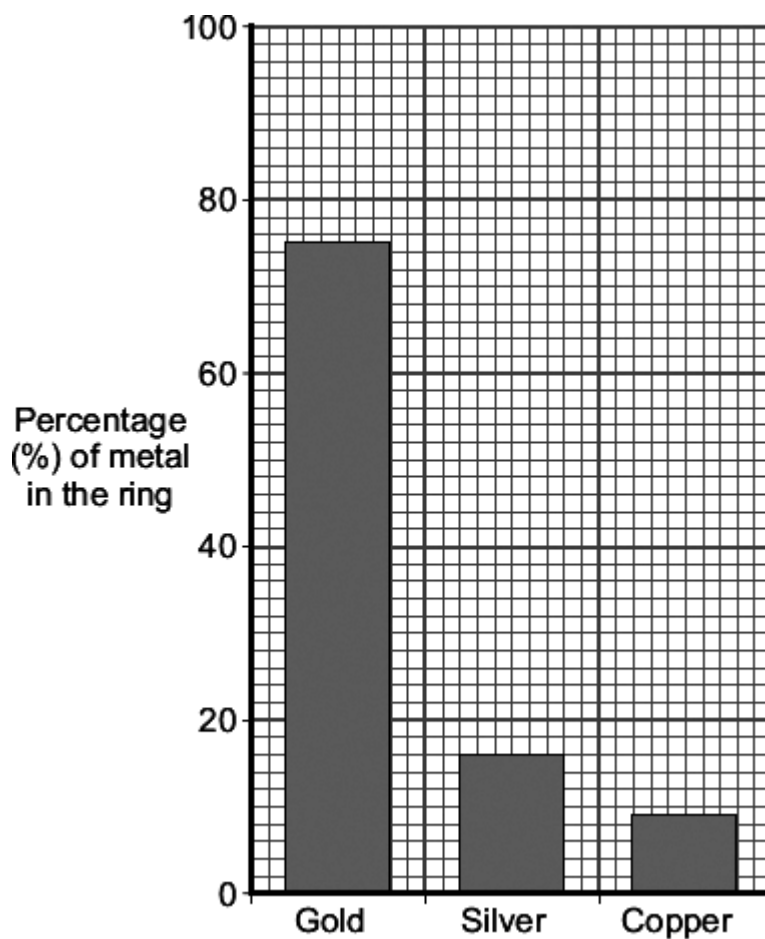
(b) A gold atom has an atomic number of 79 and a mass number of 197.

Complete the table to show the name and number of each sub-atomic particle in this gold atom.

Name	Number
Proton	79
Electron	_____
_____	_____

(3)

(c) The bar chart shows the composition of this gold ring.



(i) Give the percentage of the other two metals in this gold ring.

Silver is _____ % and copper is _____ %

(1)

(ii) This gold ring is not made from 100% gold.

Give **two** reasons why.

1. _____

2. _____

(2)

(Total 7 marks)

Q15.

Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.



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

(a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

(i) Name this type of reaction.

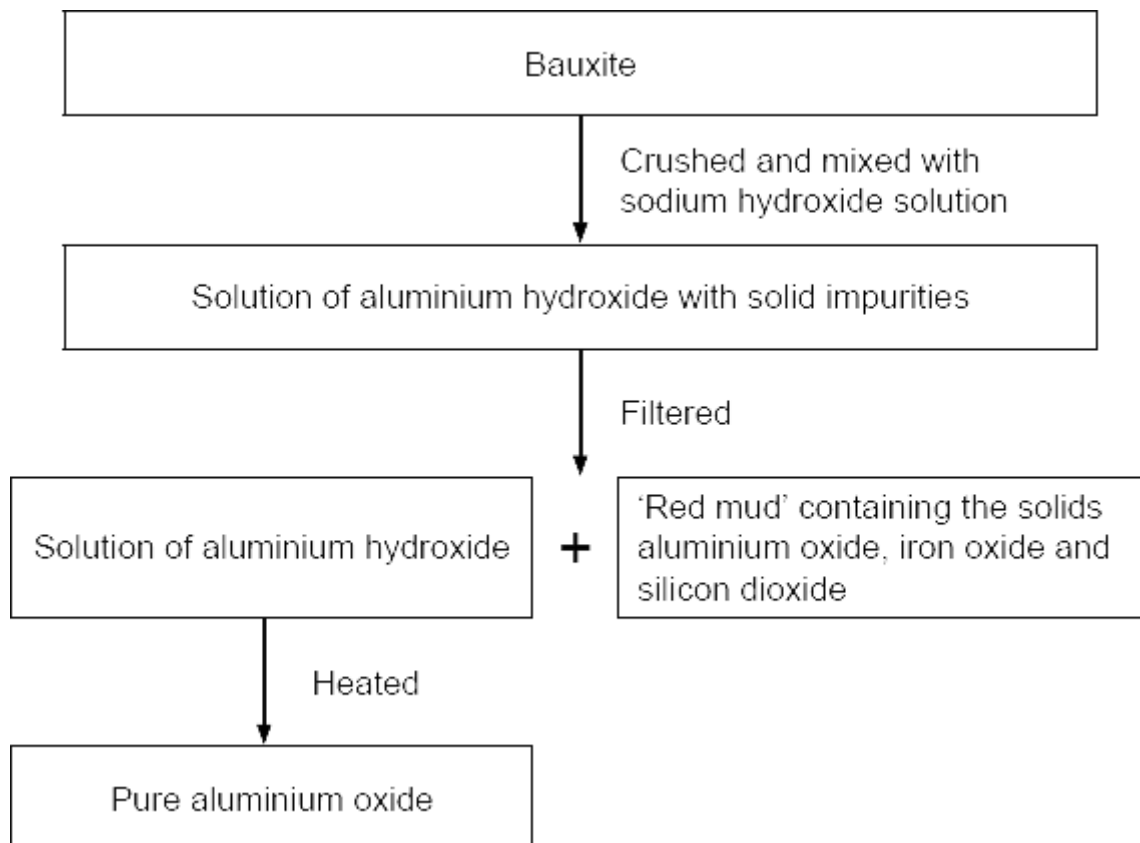
(1)

(ii) Balance the symbol equation for this reaction.



(1)

(b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide. Aluminium is extracted by electrolysis of aluminium oxide.



The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

(i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

Answer = _____ %

(1)

(ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

(1)

(iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

(1)

(c) Aluminium is used to make many things including cans.

During one year in the USA:

- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental _____

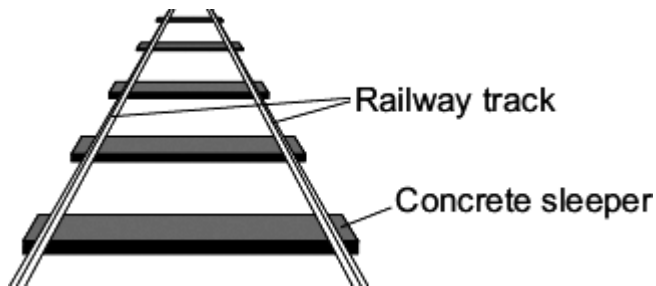
Ethical or social _____

(2)

(Total 7 marks)

Q16.

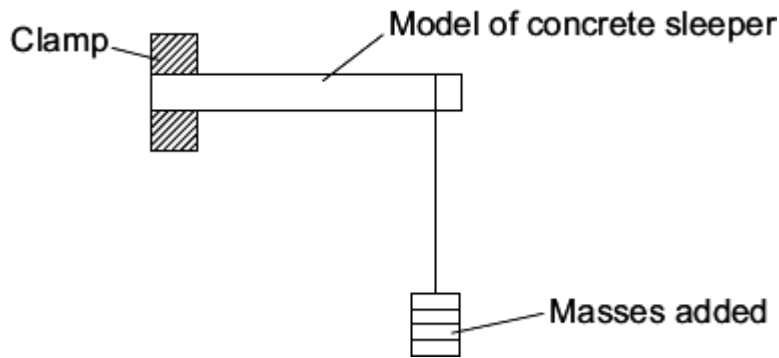
In the UK, railway sleepers are often made from concrete.



A scientist was asked to find the best concrete mixture to use so that railway sleepers would not break easily.

The scientist made:

- a mould to make small models of concrete sleepers
- concrete mixtures using crushed rock, sand, cement and water
- the equipment shown to add 0.1 kg masses until the model sleeper broke.



The scientist's results are shown in the table.

Concrete mixture in % by volume			Total mass added to break the model sleeper in kg			
Cement	Sand	Crushed rock	Test 1	Test 2	Test 3	Mean
10	70	20	1.1	1.3	1.2	1.2
20	60	20	2.6	2.5	2.4	
30	50	20	3.3	3.3	3.3	3.3
40	40	20	3.8	4.0	3.3	3.9
50	30	20	4.5	4.2	4.3	4.3

- (a) (i) Calculate the mean total mass added to break the model sleeper that has 20% cement by volume.

Mean = _____ kg

(1)

- (ii) Choose **one** result in the table that the scientist should check and test again.

Result: % cement by volume _____ Test number _____

Explain why you chose this result.

(2)

- (iii) What is the relationship between the total mass to break the model sleeper and the percentage (%) of cement by volume in the concrete mixture?

(1)

- (iv) Suggest **one** other variable that the scientist should have recorded in the table of results.

(1)

- (b) The scientist thought that full-size railway sleepers should be made from 30% cement, 50% sand and 20% crushed rock.

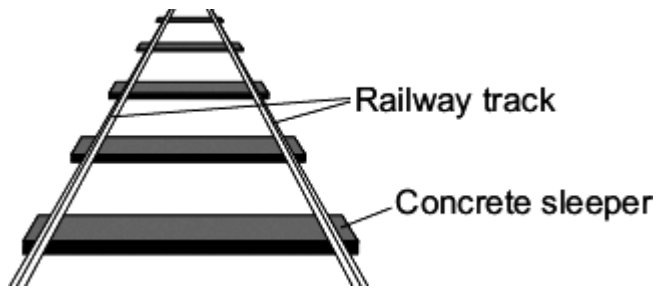
What other information about these three materials is needed before the scientist recommends using this mixture to make a full-size railway sleeper?

(2)

(Total 7 marks)

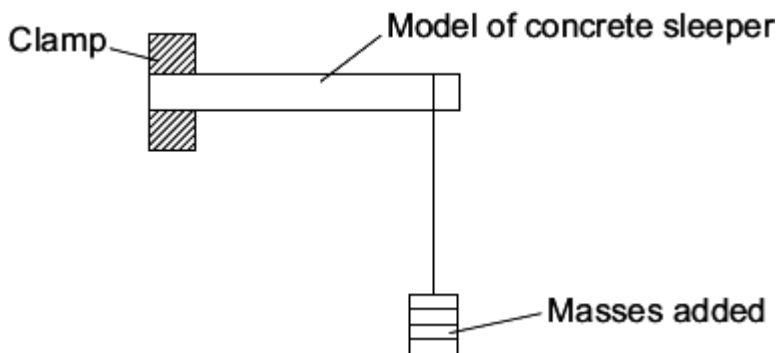
Q17.

In the UK, railway sleepers were made from wood. They are now often made from concrete.



A scientist was asked to find the best concrete mixture to use so that railway sleepers would not break easily. The scientist made:

- a mould to make small models of concrete sleepers
- concrete mixtures using crushed rock, sand, cement and water
- the equipment shown to add 0.1 kg masses until the model sleeper broke.



The scientist's results are shown in the table.

Concrete mixture in % by volume	Total mass added to break the model sleeper in kg
---------------------------------	---

Cement	Sand	Crushed rock	Test 1	Test 2	Test 3	Test 4	Mean
10	70	20	1.2	1.1	1.3	1.2	1.2
20	60	20	3.0	2.6	2.5	2.4	
30	50	20	3.5	3.3	3.3	3.3	3.3
40	40	20	3.9	3.8	4.0	3.3	3.9
50	30	20	4.2	4.5	4.2	4.3	4.3

- (a) Calculate the mean total mass added to break the model sleeper that has 20 % cement by volume.

Mean = _____ kg

(2)

- (b) State **one** conclusion that the scientist could make from these results.

(1)

- (c) The scientist sent the results in a report to a company that makes full-size concrete railway sleepers.

- (i) Suggest **two** other factors that the company should take into consideration before deciding which mixture to use to make a full-size concrete railway sleeper.

(2)

- (ii) The scientist's report claimed that using concrete sleepers instead of wooden sleepers would have less environmental impact.

Do you agree with the scientist's claim?

Use your knowledge and understanding to justify your answer.

Remember to compare using concrete with using wood for the sleepers.

(4)
(Total 9 marks)

Q18.

- (a) Ammonia solution is used in cleaning products to remove grease from kitchen surfaces.



Ammonia solution is alkaline.

- (i) Draw a ring around the number most likely to be the pH of ammonia solution.

1 3 7 10

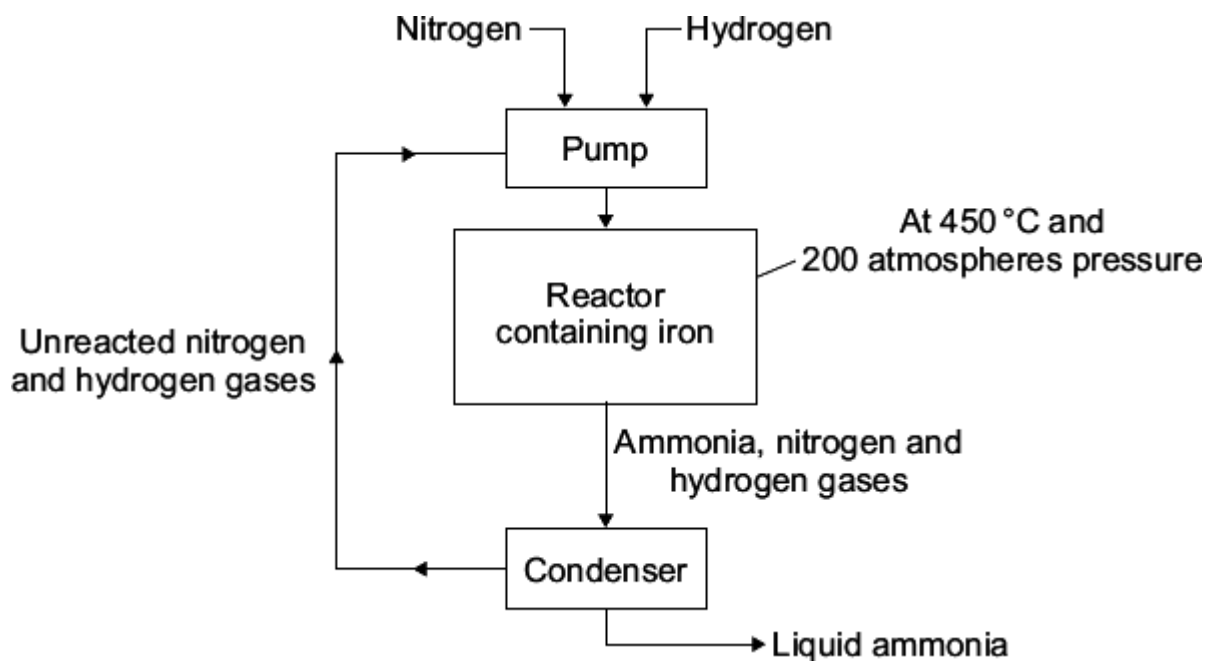
(1)

- (ii) Draw a ring around the ion in ammonia solution which makes it alkaline.

Cl^- H^+ Na^+ OH^-

(1)

- (b) Ammonia is made using the Haber process.



- (i) Where does the nitrogen used in the Haber process come from?
 Draw a ring around your answer.

air natural gas water

(1)

- (ii) A high temperature of 450 °C is used in the reactor.

Tick (✓) **two** reasons in the table which explain why high temperatures make reactions faster.

Reasons	Tick (✓)
Particles move faster	
Particles are closer together	
Particles collide more often	
Particles have less energy	

(2)

- (iii) The iron in the reactor speeds up the reaction but is not used up.

What is the name given to substances that speed up the chemical reaction but which are not used up during the reaction?

(1)

- (c) Complete the sentence.

The condenser separates the ammonia from the unreacted nitrogen and hydrogen by turning the ammonia into a _____

(1)

(Total 7 marks)

Q19.

Gold and gold ions are used as catalysts.

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



Complete the sentences.

The atomic number of gold is _____

The number of electrons in an atom of gold is _____

(2)

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

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

A gold nanoparticle contains a few

hundred

thousand

million

atoms.

(1)

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



- (i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called _____

(1)

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

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

one.

two.

three.

(1)

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

How does a catalyst help a reaction?

(1)

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

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

When heated, a thermosoftening polymer will

dissolve.

melt.

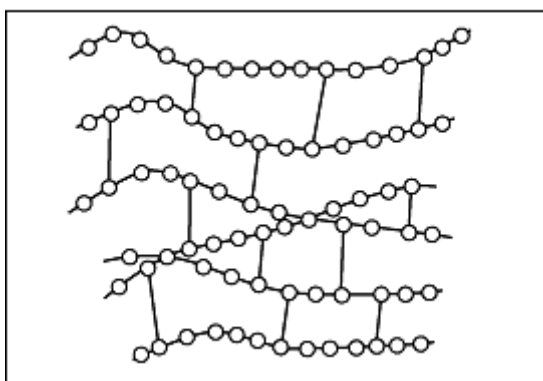
solidify.

(1)

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

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

Polymer B



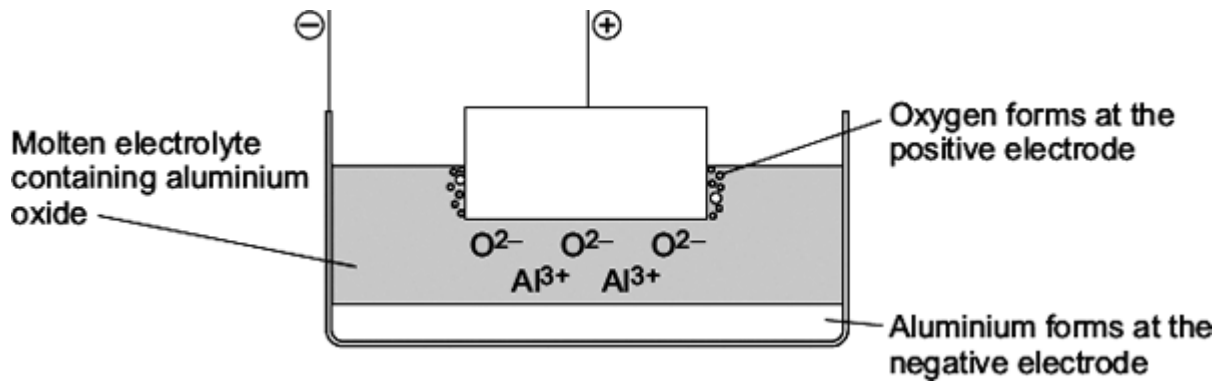
How can you tell from the diagram that polymer **B** is **not** thermosoftening?

(1)

(Total 8 marks)

Q20.

The diagram represents an electrolysis cell for extracting aluminium.
The current will only flow when the electrolyte is molten.



(a) The electrolyte is aluminium oxide mixed with another substance.

(i) What is the name of the other substance in the electrolyte?

Draw a ring around the correct answer.

cryolite

rock salt

limestone

(1)

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

This other substance is added to

- condense the aluminium oxide.
- lower the melting point of the aluminium oxide.
- raise the boiling point of the aluminium oxide.

(1)

(b) (i) Oxide ions (O^{2-}) move to the positive electrode.

Explain why.

(2)

(ii) Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.



Complete the sentence.

The name of the element which reacts with oxygen is _____

(1)

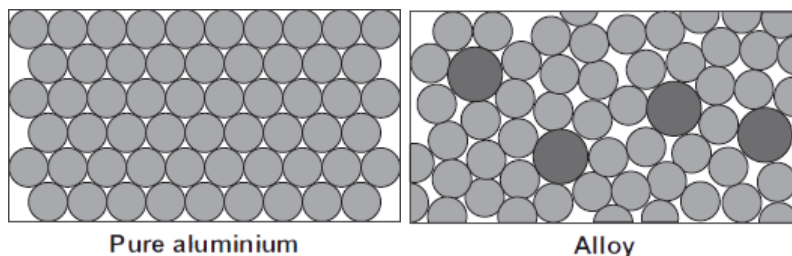
(iii) The positive electrode gets smaller.

Suggest why.

(1)

- (c) Aluminium is used in an alloy with magnesium to make drinks cans.

The diagrams show the arrangement of atoms in pure aluminium and in the alloy.



The alloy is harder than pure aluminium.

Explain why. Use the diagrams to help you.

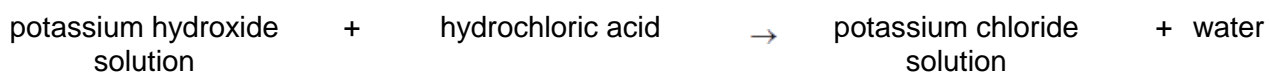
(2)

(Total 8 marks)

Q21.

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

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.



Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

alone?

Tick (✓) **one** question.

Question	Tick (✓)
How much ammonium nitrate is in drinking water?	
Should farmers stop using ammonium nitrate on their farmland?	
Is ammonium nitrate soluble in rain water?	

Give **two** reasons why this question **cannot** be answered by science alone.

(3)

(Total 11 marks)

Q22.

Iron is extracted from its ore.

(a) Iron ore is quarried.



Photograph supplied by Stockbyte/Thinkstock

Quarrying iron ore has impacts that cause environmental problems.

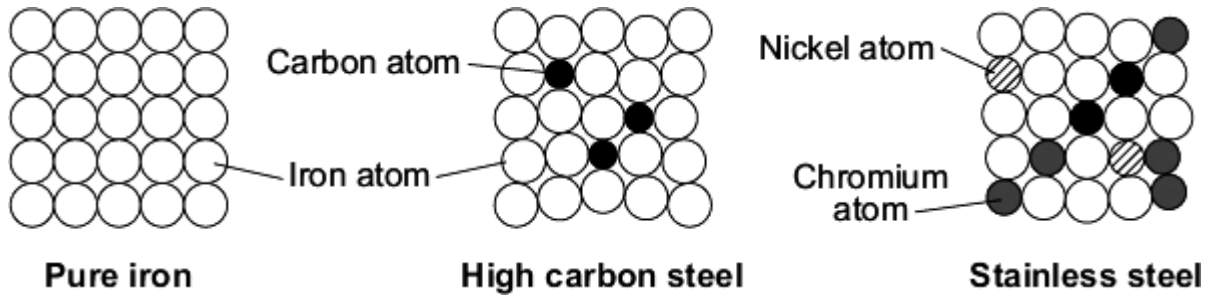
Tick (✓) **two** impacts of quarrying that cause environmental problems.

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

puts off tourists	
causes dust pollution	
increases jobs	
increases traffic	

(2)

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



Use the diagrams to help you to answer these questions.

(i) Complete the sentence.

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

_____ (1)

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

Suggest why.

 _____ (1)

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

(i) Pure iron is

- a
compound.

an element.

a mixture.

(1)

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

- brittle.

easily bent.

hard.

(1)

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

contains three different atoms.

melts at a very high temperature.

is resistant to corrosion.

(1)

(Total 7 marks)

Q23.

Steels are used to make cars, bridges and knives.
The main element in steel is iron.

(a) Iron is extracted from an *ore* that contains about 60% iron oxide, Fe_2O_3

(i) What is the meaning of *ore*?

(1)

(ii) In a blast furnace, iron oxide reacts with carbon monoxide to produce iron.
The word equation for this reaction is:

iron oxide + carbon monoxide \rightarrow iron + carbon dioxide

Complete and balance the chemical equation for this reaction.



(2)

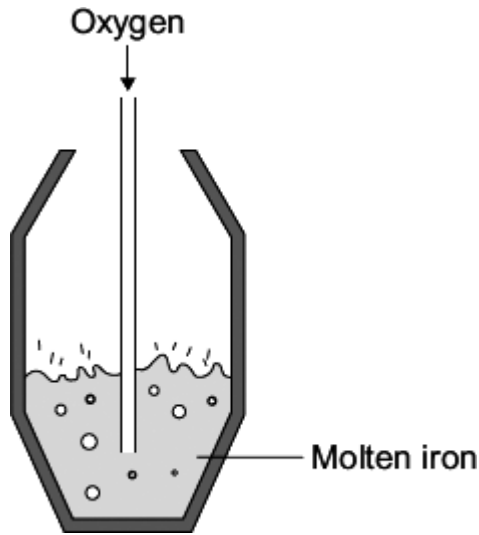
(iii) Name the type of reaction that produces a metal from its metal oxide.

(1)

(b) Steels are produced from molten iron in two stages:

Stage 1 blowing oxygen into molten iron from the blast furnace.

Stage 2 adding other metals to make different steels.



- (i) In **Stage 1**, suggest how the oxygen removes most of the carbon from the molten iron.

(2)

- (ii) **Stage 2** produces different steels.

Suggest why different steels are needed.

(1)

- (c) Old 5p and 10p coins in the UK were made from cupro-nickel. Cupro-nickel is 75% copper and 25% nickel.

New 5p and 10p coins in the UK are now made from nickel-plated steel and not from cupro-nickel.

Explain why.

(2)

(Total 9 marks)

Q24.

Read the article and then answer the questions.

Supermarkets launch eco-friendly plastic milk bags. Could this be the end of the milk bottle?



Milk bottles are made from glass or from plastic.

Glass milk bottles contain 0.5 litres of milk. When the milk is used up the empty bottles are returned to be re-used. Glass milk bottles are re-used 24 times on average. The glass to make new milk bottles is produced when a mixture of sand, limestone, soda and recycled glass is heated to about 1600 °C in a furnace. There are almost unlimited amounts of the raw materials needed to produce this glass. About 35% of used glass is recycled.

The most common plastic milk bottles contain 2 litres of milk. When the milk is used up the empty bottles are discarded as waste. The plastic used to make these milk bottles is poly(ethene). Poly(ethene) is produced from crude oil by first using fractional distillation, then cracking the naphtha fraction and finally polymerising the ethene. About 5% of used poly(ethene) is recycled.

The new plastic milk bags contain 2 litres of milk. The milk bags are also made from poly(ethene). A milk bag uses 75% less poly(ethene) than is used to make the poly(ethene) milk bottles. When the milk is used up the empty bags are discarded as waste.

- (a) Describe what happens in fractional distillation so that fractions, such as naphtha, are separated from crude oil.

(3)

- (b) Supermarkets claim that using milk bags instead of milk bottles would have less environmental impact.

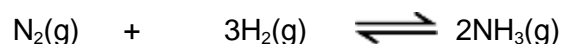
Do you agree with this claim?

Use the information in the article and your knowledge and understanding to make appropriate comparisons to justify your answer.

- (a) How is ammonia separated from unreacted nitrogen and hydrogen in the separator?

(2)

- (b) The equation shows the reaction which takes place in the reactor:



- (i) Why does the yield of ammonia at equilibrium increase as the temperature is decreased?

(1)

- (ii) A temperature of 450 °C is used in the reactor to make the reaction take place quickly.

Explain, in terms of particles, why increasing the temperature makes a reaction go faster.

(2)

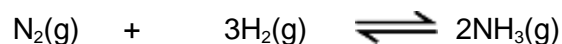
- (iii) Why does the yield of ammonia at equilibrium increase as the pressure is increased?

(1)

- (iv) The pressure used in the reactor is 200 atmospheres. Suggest why a much higher pressure is **not** used.

(1)

- (c) Use the equation for the reaction in the reactor to help you to answer these questions.



- (i) It is important to mix the correct amounts of hydrogen and nitrogen in the reactor.

20 m³ of nitrogen is reacted with hydrogen.

What volume of hydrogen (measured at the same temperature and pressure as the nitrogen) is needed to have the correct number of molecules to react with the nitrogen?

Volume of hydrogen needed = _____ m³

(1)

- (ii) Calculate the maximum mass of ammonia that can be made from 2 g of nitrogen.

Relative atomic masses: H = 1; N = 14.

Maximum mass of ammonia = _____ g

(3)

- (d) The expected maximum mass of ammonia produced by the Haber process can be calculated.

- (i) In one process, the maximum mass of ammonia should be 80 kg.

The actual mass of ammonia obtained was 12 kg.

Calculate the percentage yield of ammonia in this process.

Percentage yield of ammonia = _____ %

(1)

- (ii) Give **two** reasons why it does **not** matter that the percentage yield of ammonia is low.

Use the flow diagram at the start of this question to help you.

(2)
(Total 14 marks)

Q26.

The flow diagram shows the main stages used to extract a metal from its ore.

mining the ore → purifying the ore → extracting the metal

The table shows some information about three metals.

Metal	Metal ore	Purified ore	% of metal in the ore	% of metal in the Earth's crust
aluminium	bauxite	aluminium oxide, Al_2O_3	28.0	8.0
copper	chalcocite	copper sulfide, Cu_2S	0.5	0.001
iron	haematite	iron oxide, Fe_2O_3	29.0	5.0

(a) Use the information in the table and your knowledge and understanding to help you to answer the questions.

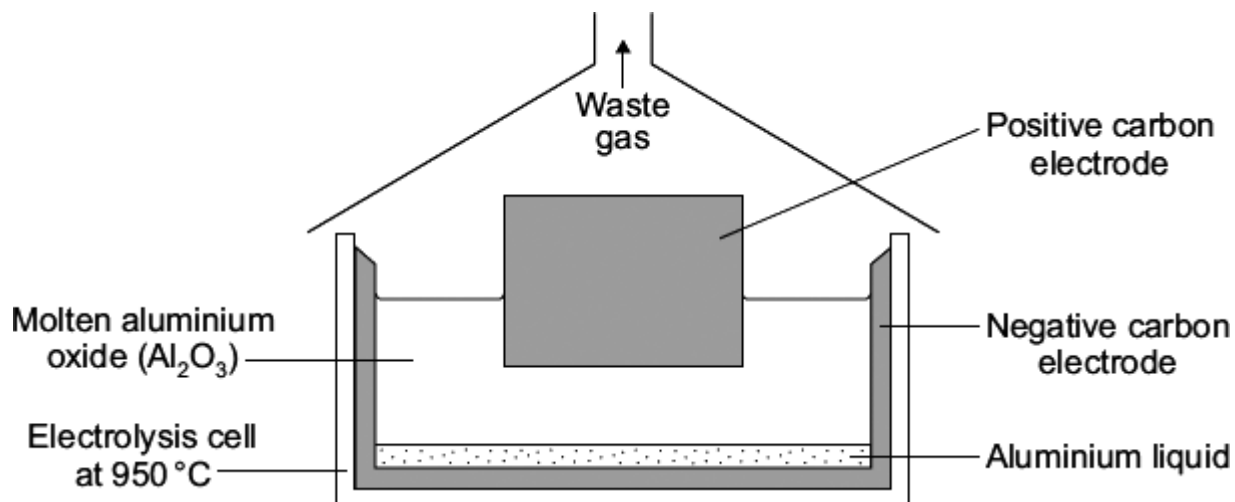
(i) Suggest why purifying the copper ore produces large quantities of waste.

(1)

(ii) Suggest why the annual world production of iron is forty times greater than that of aluminium.

(1)

(b) Aluminium is used for drinks cans.
Aluminium is extracted from its purified ore by electrolysis.



- (i) Suggest why the aluminium produced in the electrolysis cell is a liquid.

(1)

- (ii) In this electrolysis, aluminium and oxygen gas are produced from the aluminium oxide.

Use the information in the diagram to suggest why most of the waste gas is carbon dioxide and not oxygen.

(2)

- (iii) Aluminium is the most abundant metal in the Earth's crust.

Suggest **two** reasons why we should recycle aluminium drinks cans.

1. _____

2. _____

(2)

(Total 7 marks)

Q27.

Supermarkets in the UK have been advised by the Government to stop giving plastic bags to customers. The Government states that this is because plastic bags use up resources that are not renewable and that the manufacture of plastic bags produces carbon dioxide. Most of these plastic bags are made from poly(ethene). The table shows methods to deal with large numbers of used plastic bags.

Method	Description of what happens to the plastic bag
Reused	used again by the customer
Recycled	collected, transported, washed and melted to make new plastic items
Burned	collected, transported and burnt to release heat energy
Dumped	mixed with other household waste, collected, transported and disposed of at a landfill site

Use the information and your knowledge and understanding to briefly give **one advantage and one disadvantage** for each of these methods.

Reused _____

Recycled _____

Burned _____

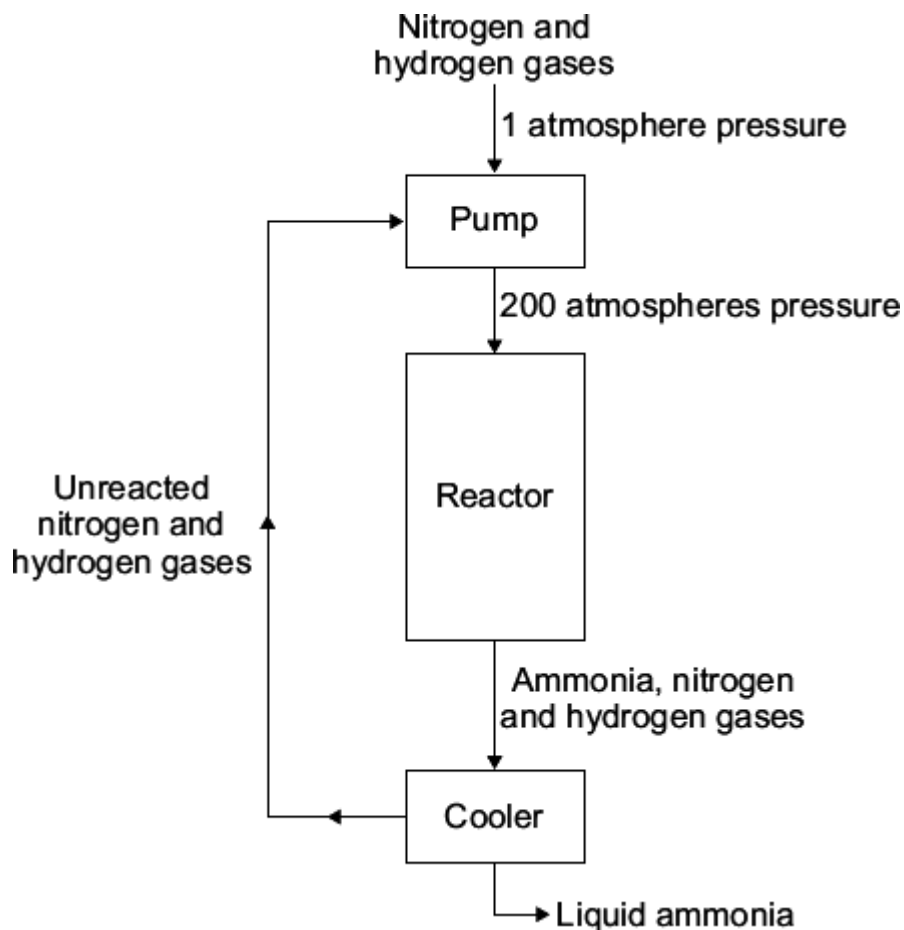
Dumped _____

(4)

(Total 4 marks)

Q28.

The flow diagram shows how ammonia is made.



- (a) What effect, if any, does the **pump** have on the pressure of the nitrogen and hydrogen?

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

The pump

decreases
has no effect on
increases

 the pressure.

(1)

- (b) The word equation for making ammonia is:



In the **reactor** only a small amount of the nitrogen and hydrogen is changed into ammonia.

Tick (✓) the reason why.

Reason why	Tick (✓)
Ammonia is formed from two elements.	
Nitrogen and hydrogen are gases.	

The reaction is reversible.	
-----------------------------	--

(1)

- (c) In the **cooler** the mixture of gases is cooled.

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

The cooler turns the ammonia into

a liquid.

a solid.

an element.

(1)

- (d) What happens to the unreacted nitrogen and hydrogen from the **reactor**?

(1)

(Total 4 marks)

Q29.

Good quality water is essential for life.

- (a) In the United Kingdom, water is filtered and treated with chlorine to make it safe to drink.



Explain why the water is:

filtered _____

treated with chlorine. _____

(2)

- (b) Millions of people in Bangladesh drink water from wells that contain high levels of arsenic. Arsenic is poisonous.

The World Health Organisation recommends that there should be no more than 0.01 mg of arsenic per litre in drinking water.

The table gives some information about two instrumental methods of testing for

Humberstone was a town in the desert of Northern Chile in South America. It was built for the people who worked in the nearby sodium nitrate mines.

The sodium nitrate was used as a fertiliser.

The sodium nitrate was exported by ship to countries all around the world.

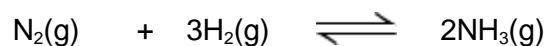
Today the mines have closed and nobody lives in Humberstone.

One of the reasons for the mines closing was the invention of the Haber process.



By Sznegra (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

(a) The Haber process is used to make ammonia (NH_3).



The forward reaction is exothermic.

(i) Name the raw materials that are used to supply the nitrogen and hydrogen.

Nitrogen _____

Hydrogen _____

(2)

(ii) The Haber process uses a temperature of $450\text{ }^\circ\text{C}$.

Explain, as fully as you can, why a temperature of $450\text{ }^\circ\text{C}$ is used rather than a much higher temperature or a much lower temperature.

(3)

(iii) Ammonia can be converted to ammonium nitrate by adding an acid.

Name this acid.

(1)

(b) Suggest and explain why the invention of the Haber process caused the closure of the Humberstone mines in Chile.

(2)

(Total 8 marks)

Q31.

Read the following information and then answer the questions.

Chlorine – for better, for worse?



Chlorine is used to make bleaches, plastics and medicines. Swimming pool water is often treated with chlorine.

Chlorine is used to make water safe to drink. It is relatively cheap and easy to use. People who drink untreated water risk dying from typhoid and cholera.

However, chlorine is a poisonous chemical. It causes breathing difficulties and can kill people. Some people are also allergic to chlorine.

(a) How does chlorine make water safe to drink?

(1)

(b) The amount of chlorine in swimming pool water should be carefully monitored and controlled.

Explain why.

(2)

(c) Developing countries are likely to choose chlorination as their method of making water safe to drink.

Suggest why.

(1)

(d) A government is setting up an enquiry into the safety of using chlorine.

(i) Suggest why people from all political parties should be represented.

(1)

(ii) Suggest why the opinion of a well-respected scientist might change the outcome of any discussion.

(1)

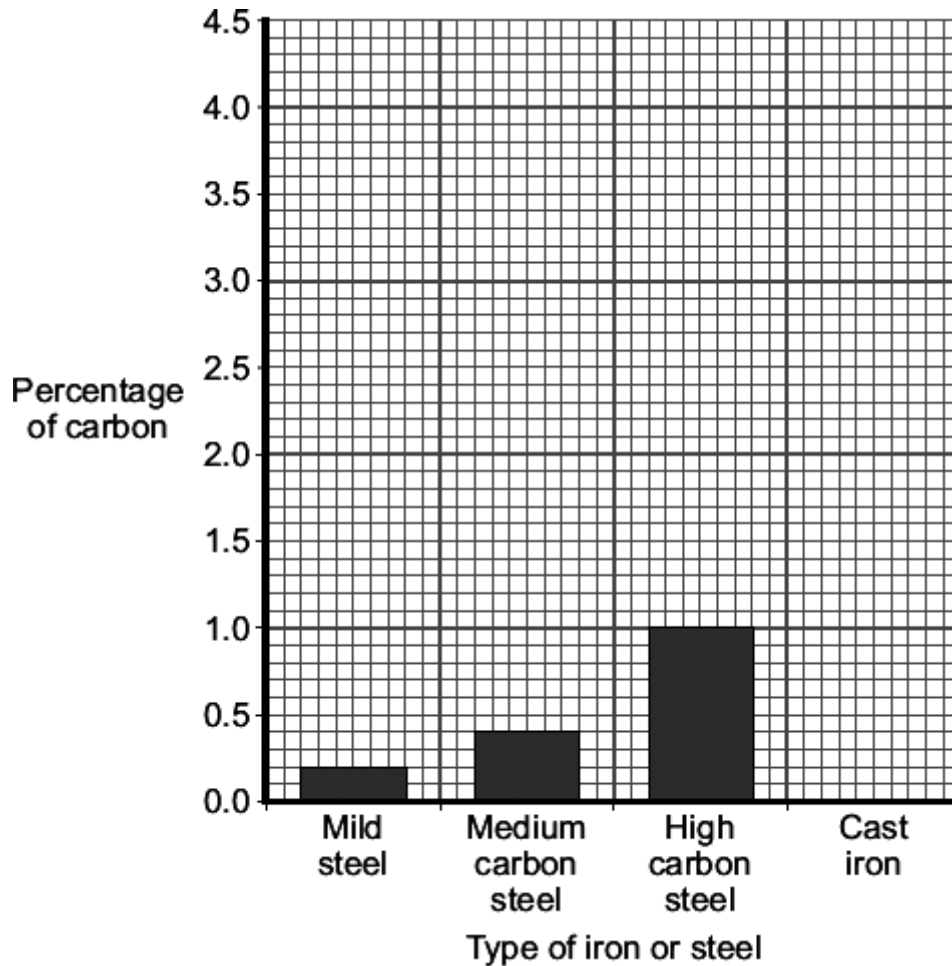
(iii) The decision taken about the safety of using chlorine should be based on evidence and data rather than on hearsay and opinion.

Suggest why.

(1)
(Total 7 marks)

Q32.

The bar chart shows the percentage of carbon in three types of steel.



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

Steel is the name used for

alloys
atoms
ores

 of iron.

(1)

- (b) Cast iron contains 4% carbon.

Draw the bar for cast iron on the chart.

(1)

- (c) Cast iron is more brittle than these three types of steel.

Use the bar chart to suggest why.

(1)

(d) One type of stainless steel contains iron with 0.2% carbon to which 8% nickel and 18% chromium were added.

(i) Tick (✓) the percentage of iron in this type of stainless steel.

Percentage (%) of iron	Tick (✓)
92.4	
88.6	
73.8	

(1)

(ii) Use the bar chart to name the type of steel that contains only 0.2% carbon.

(1)

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

Stainless steel is used for knives and forks because it is resistant to

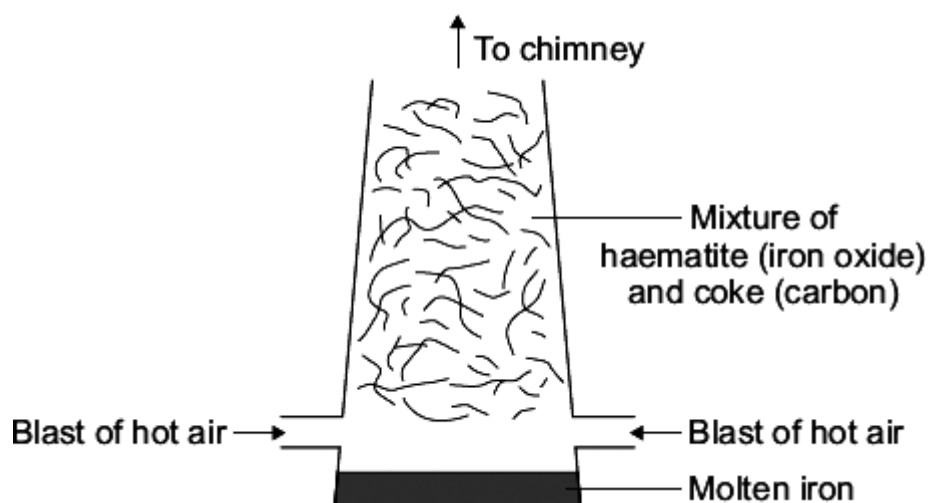
corrosion.
decomposition.
distillation.

(1)

(Total 6 marks)

Q33.

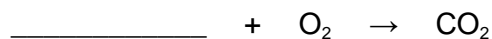
Iron is produced by reacting a mixture of haematite and coke in a blast furnace. Haematite is an ore of iron containing iron oxide (Fe_2O_3). Coke is made from coal and is almost pure carbon.



(a) (i) The coke burns in air. This reaction heats the furnace to above 1300 °C.

Complete the chemical equation for carbon reacting with oxygen to form

carbon dioxide.



(1)

- (ii) Carbon monoxide is also formed in the furnace. Carbon monoxide reacts with iron oxide to produce iron and carbon dioxide.

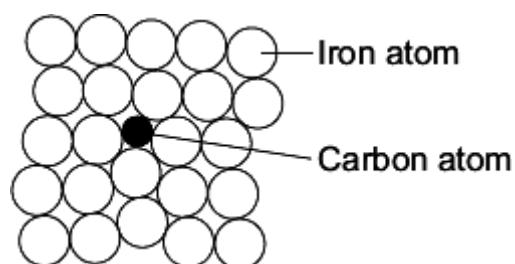


Complete and balance the chemical equation for the production of iron.



(2)

- (iii) Iron from a blast furnace is called cast iron and contains about 4% carbon.



Why is pure iron softer than cast iron?

(1)

- (b) Steel is made by reducing the percentage of carbon in cast iron and then adding different metals to form the type of steel required.

In the UK we use about 1.8 billion steel cans every year but only 30% of these are recycled. Recycling reduces waste. Producing steel from recycled cans requires only 25% of the energy needed to make steel from iron ore.

Give **three** environmental benefits of recycling a higher percentage of used steel cans.

1.

2.

3.

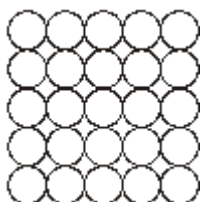
(3)

(Total 7 marks)

Q34.

Iron is the main structural metal used in the world.

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



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

Iron is described as an element because all the

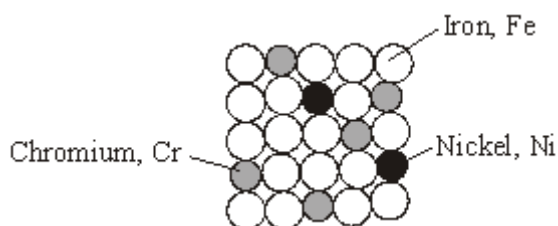
atoms
compounds
metals

are the same.

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.



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

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

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

An alloy is made up of more than one type of _____.

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

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

(4)

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

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

(i) Give **two** reasons, from the information above, to explain why recycling used

steel cans is a good idea.

1. _____

2. _____

(2)

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

(1)

(Total 8 marks)

Q35.

Water sold in plastic bottles has a high 'carbon cost'.

The 'carbon cost' depends on the amount of carbon dioxide emitted in making and transporting the product.

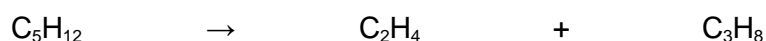
The more carbon dioxide emitted, the higher the 'carbon cost'.

- (a) Plastic water bottles are made from a polymer.
The polymer is made from ethene.
Ethene is made by cracking hydrocarbons.

- (i) Name the polymer made from ethene.

(1)

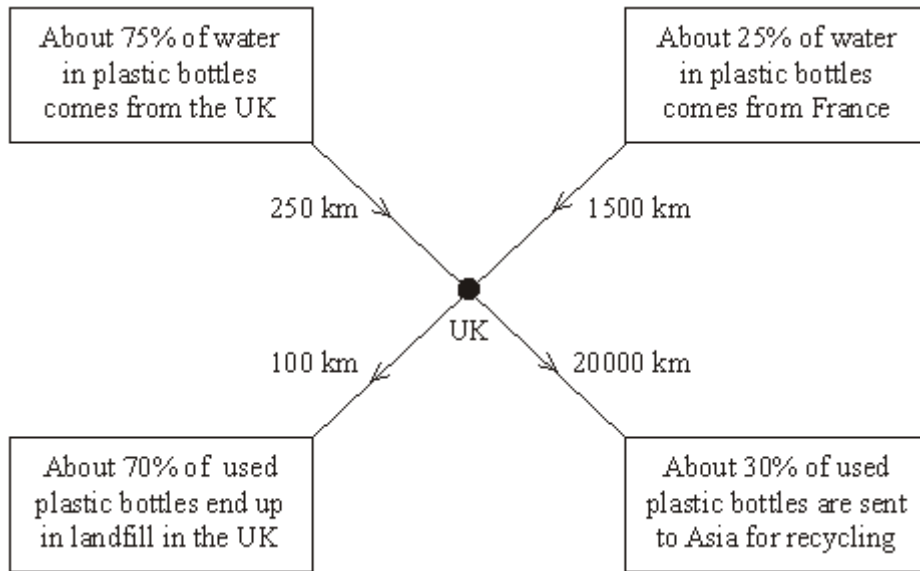
- (ii) Ethene can be made by cracking the hydrocarbon pentane, C_5H_{12} .



Explain why there is a 'carbon cost' for the process of cracking a hydrocarbon.

(2)

- (b) The diagram shows information about water sold in plastic bottles in the UK.
The diagram also shows the average distances that water and plastic bottles are transported.



Suggest how the high 'carbon cost' of water sold in plastic bottles could be reduced.

(3)
(Total 6 marks)

