OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



EXAM QUESTION PACK

C6.1 IMPROVING PROCESSES AND PRODUCTS

SCORE	PERCENTAGE
/331	%

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Gateway Chemistry A (9-1)

improving processes and products

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **331**.
- The total number of marks may take into account some 'either/or' question choices.

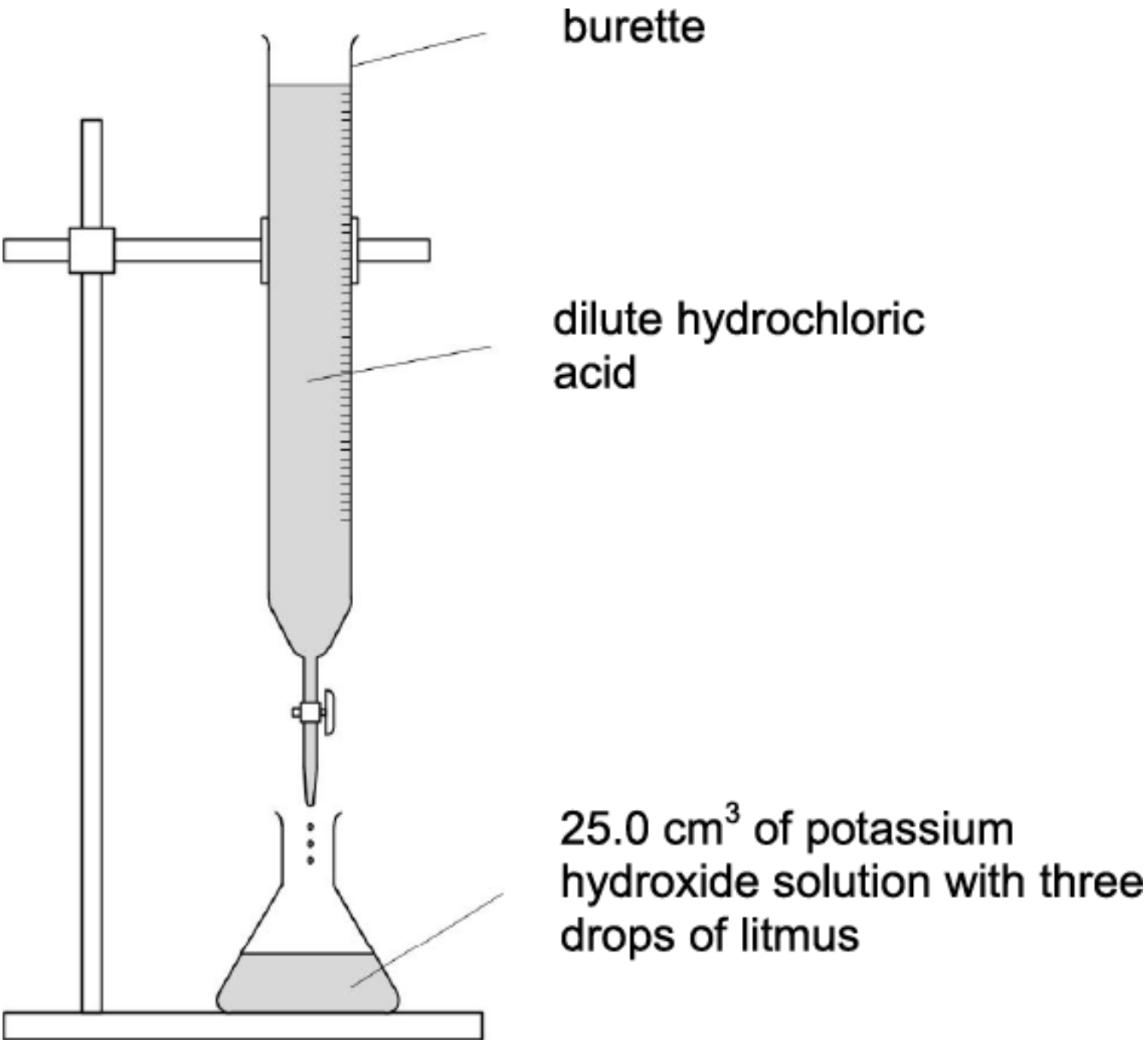
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1(a) Sarah does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Look at the apparatus she uses.

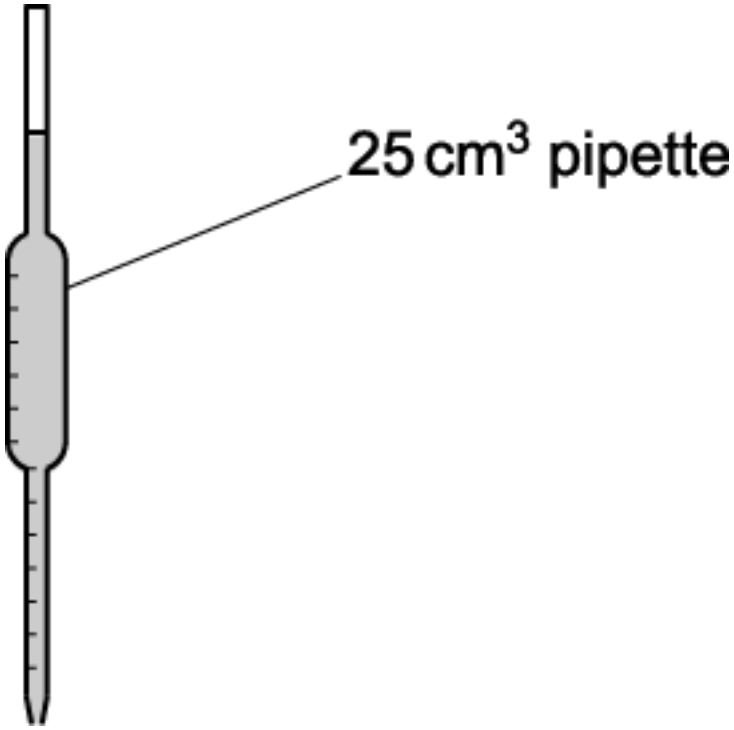


Sarah uses a pipette to measure out the 25.0 cm^3 of potassium hydroxide solution.

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Describe and explain one safety precaution Sarah uses with the pipette.

---

[2]

(b) In her first titration Sarah measures the initial volume of hydrochloric acid in the burette.

She slowly adds the acid until the potassium hydroxide is just neutralised.

She then measures the volume of the hydrochloric acid again.

Describe how Sarah can tell when the potassium hydroxide solution is just neutralised.

---

[2]

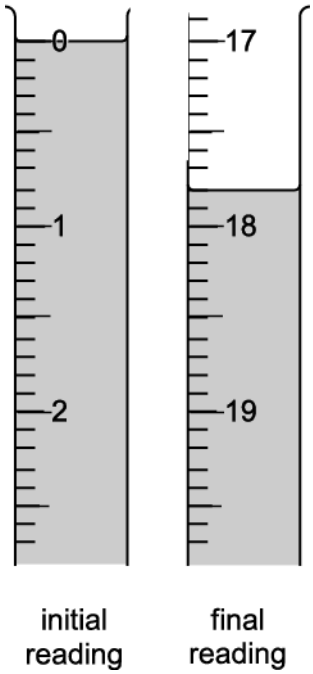
(c) Look at the diagrams. They show parts of the burette during the first titration.

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first titration



Here is Sarah's results table.

Titration number	1	2	3
final reading in cm^3		37.5	32.1
initial reading in cm^3		20.4	15.0
titre (volume of acid added) in cm^3		17.1	17.1

(i) **Complete** the table by reading the burette readings from the diagrams.

[2]

(ii) Sarah thinks the mean titre is 17.1 cm^3.

Is she correct?

Explain your answer.

---

[1]

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2 Polymers can be used to make clothes such as socks and jumpers.

Suggest **one** property of polymers that make them suitable for these uses.

---

[1]

3(a) Ammonium sulfate is a salt.

It is manufactured using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

What type of reaction is this?

---

[1]

(b) A student has a solution of ammonium sulfate.

Describe how he can obtain a pure dry sample of ammonium sulfate.

---

[1]

4(a) Iron rusts when it gets wet.

The word equation for rusting is

iron + water + oxygen → rust (hydrated iron(III) oxide)

Balance the symbol equation for the formation of rust.

……Fe(s) + $6H_2O(l)$ +…… $O_2(g)$ → $2\ Fe_2O_3.3H_2O(s)$

[2]

(b)

(i) Calculate the percentage by mass of iron in rust.

Give your answer to 2 decimal places.

Relative formula mass of rust = 213.6

[2]

_____ %

(ii) An iron bar is left outside in the rain to rust.

It has a mass of 1.0 kg.

A student predicts that the mass of the bar will increase by no more than 0.8 kg if it completely turns to rust.

Do a calculation to work out the mass of rust produced, if the bar completely turns to rust, to see if the student is correct.

Give your answer to the nearest gram.

Mass of rust = _____ g

Is the student's prediction correct and why?

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[3]

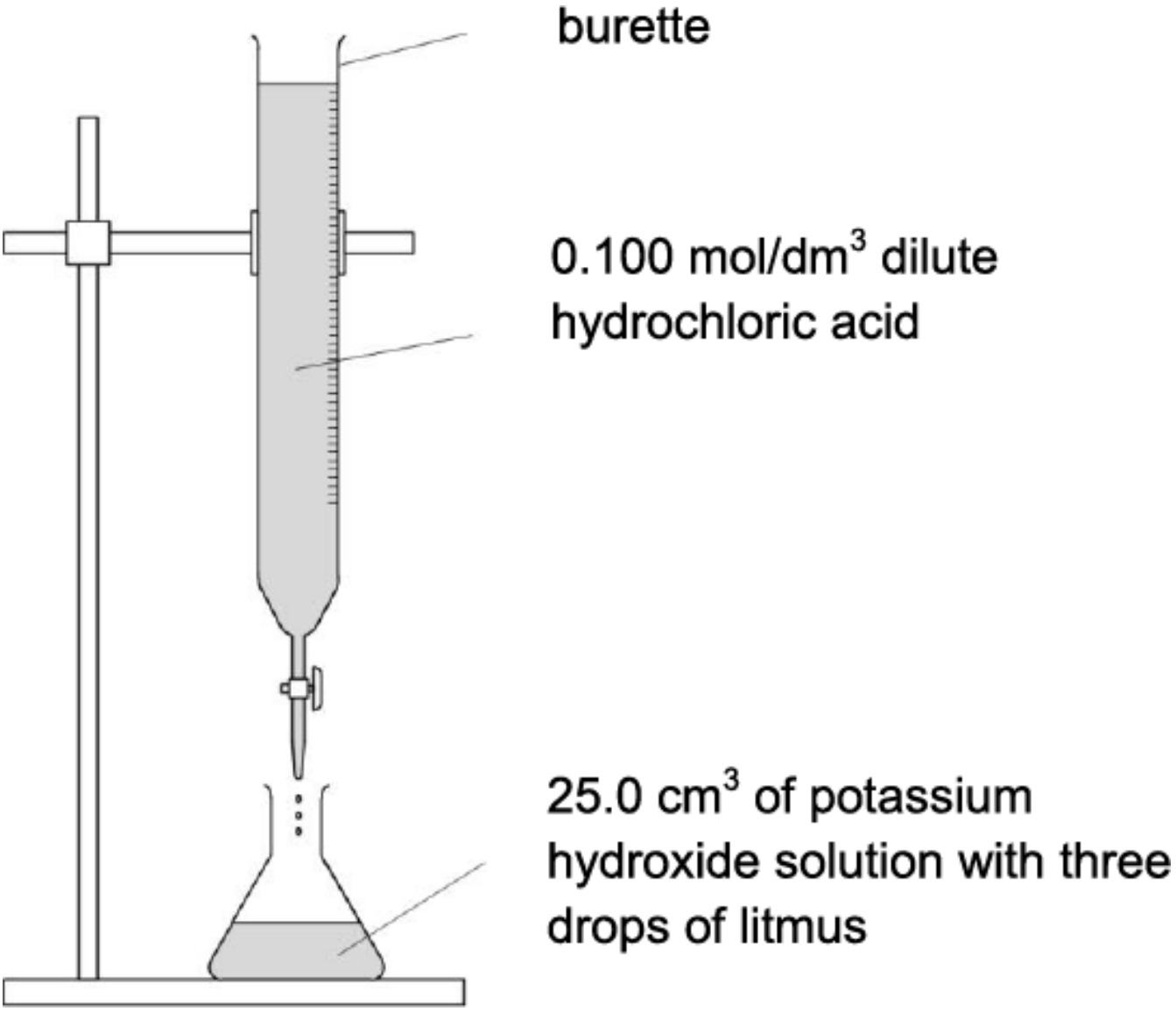
5(a) Sarah does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Hydrochloric acid neutralises the alkali potassium hydroxide.

$$HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$$

Look at the apparatus she uses.

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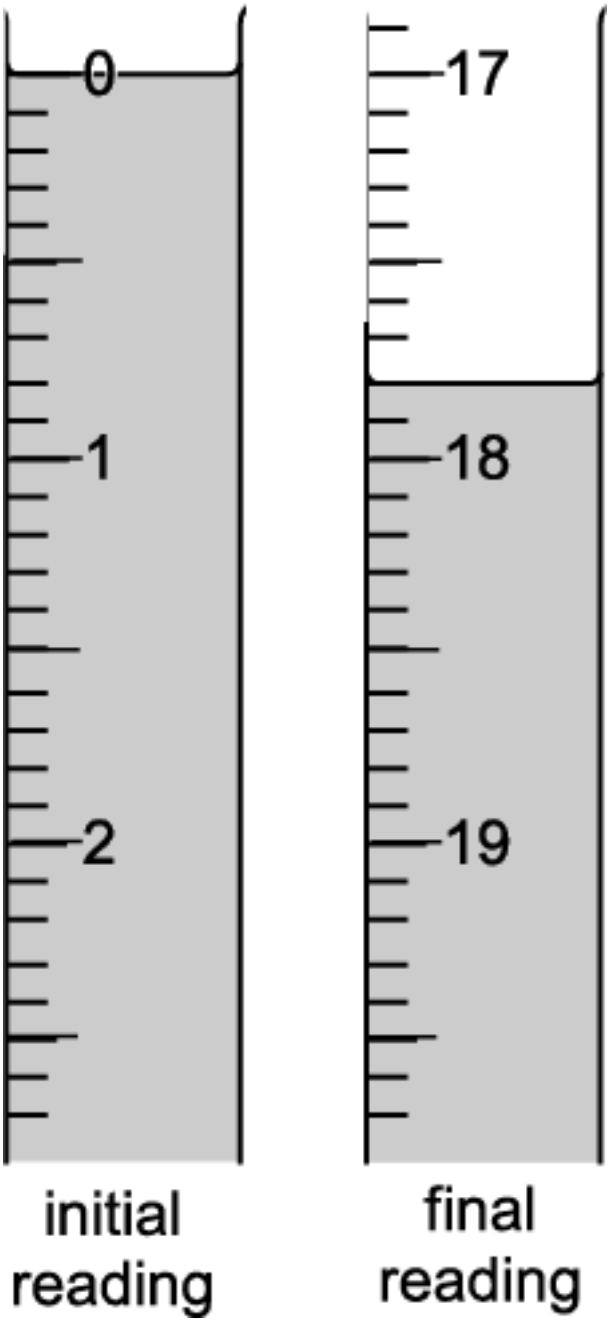
Look at the diagrams. They show parts of the burette during the first titration.

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First titration



Here is Sarah's results table:

Titration number	1	2	3
final reading (cm^3)		37.5	32.1
initial reading (cm^3)		20.4	15.0

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titre (volume of acid added) (cm_3)		17.1	17.1

Use the diagrams and table to help you calculate the mean titre.

Explain your answer.

Mean titre = _____ cm^3 **[2]**

(b) Sarah uses 25.0 cm^3 of potassium hydroxide solution, KOH.

She also uses hydrochloric acid with a concentration of 0.100 mol/dm^3.

Calculate the concentration, in mol/dm^3, of the KOH(aq).

Concentration of KOH(aq) = _____ mol/dm^3 **[2]**

(c) Use your answer to **(b)** to calculate the concentration of the KOH(aq) in g/dm^3.

Concentration of KOH(aq) = _____ g/dm^3 **[2]**

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6(a) Ammonium sulfate, $(NH_4)_2SO_4$, is a fertiliser.

Ammonium sulfate can be manufactured from ammonia and sulfuric acid.

The Haber Process is used to manufacture ammonia. Scientists think that the Haber Process is one of the most important chemical reactions.

Explain the importance of the Haber Process in agriculture.

---

[2]

(b) Ammonium sulfate is a salt.

It is made using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

(i) Describe how a sample of solid ammonium sulfate is prepared in a laboratory.

Explain why this method is not suitable to be used industrially.

---

[4]

(ii) Predict the maximum mass of ammonium sulfate that can be made from 51 tonnes of ammonia.

Maximum mass = _____ tonnes [2]

7(a) Kasia investigates the corrosion of different metals.

She places a small strip of each metal in different samples of air.

She leaves the metals for one week before collecting her results.

Look at her table of results.

Metal	Original appearance of metal	Appearance of metal after one week in			
		moist acidic air	moist alkaline air	dry air	moist air
aluminium	shiny silver	dull silver	dull silver	shiny silver	shiny silver
copper	shiny red-orange	dull red-orange	green red-orange	shiny red-orange	dull red-orange
iron	shiny silver	brown coating	brown coating	shiny silver	brown coating
magnesium	shiny silver	whitish coating	dull silver	shiny silver	dull silver
zinc	shiny silver	dark coating	dark coating	shiny silver	dull silver

Suggest, with a reason, one change to the experimental procedure that would improve the quality of the results.

---

[1]

(b) Explain the conclusions that can be made from Kasia's results.

---

[3]

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8(a) Aluminium is extracted from its ore using electrolysis.

Copper is extracted from its ore by heating with carbon.

Explain why different methods are used to extract aluminium and copper.

---

[2]

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

The electrolysis of molten aluminium oxide makes aluminium and oxygen.

(i) Write the **balanced symbol** equation for the electrode reaction that happens at the cathode.

Use the symbol e^- to represent an electron.

---

[1]

(ii) Solid aluminium oxide cannot be electrolysed.

Explain why.

---

[1]

9(a) Iron rusts when it gets wet.

The word equation for rusting is

iron + water + oxygen → rust (hydrated iron(III) oxide)

Balance the symbol equation for the formation of rust.

……Fe(s) + ……H_2O(l) + ……O_2(g) → ……$Fe_2O_3.3H_2O$(s)

[2]

(b) A 1.0 kg iron bar is left outside in the rain.

All of the iron turns to rust.

The rust forms at a rate of 60 g per day.

Calculate how long it will take for the iron bar to turn completely to rust.

Give your answer to the nearest day.

_____ days

[6]

10(a) Farmers use fertilisers to improve crop yield.

Fertilisers contain one or more of the three essential elements.

These essential elements are nitrogen, phosphorus and potassium.

Fertilisers made in factories are called **synthetic** fertilisers.

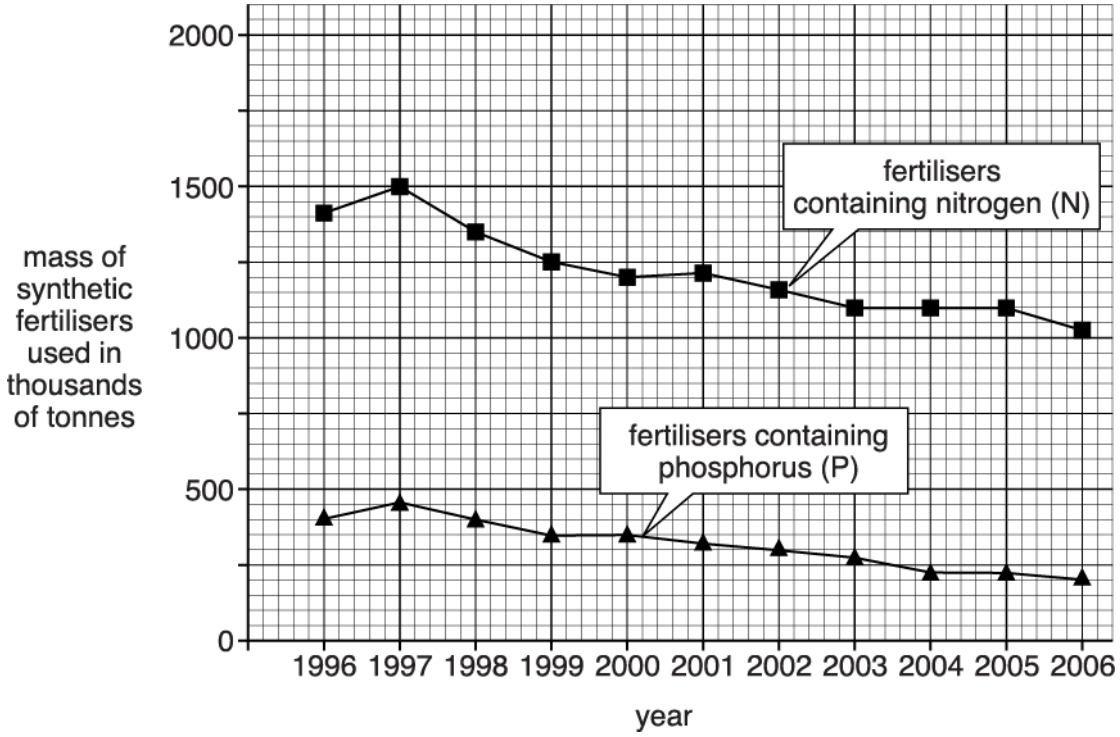
Look at the graph.

It shows the use of some synthetic fertilisers in the UK between 1996 and 2006.

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(i) What mass of fertilisers containing **nitrogen** was used in 1997?

_____ thousands of tonnes

[1]

(ii) Describe the general trend in the use of these synthetic fertilisers in the UK from 1996 to 2006.

---

[1]

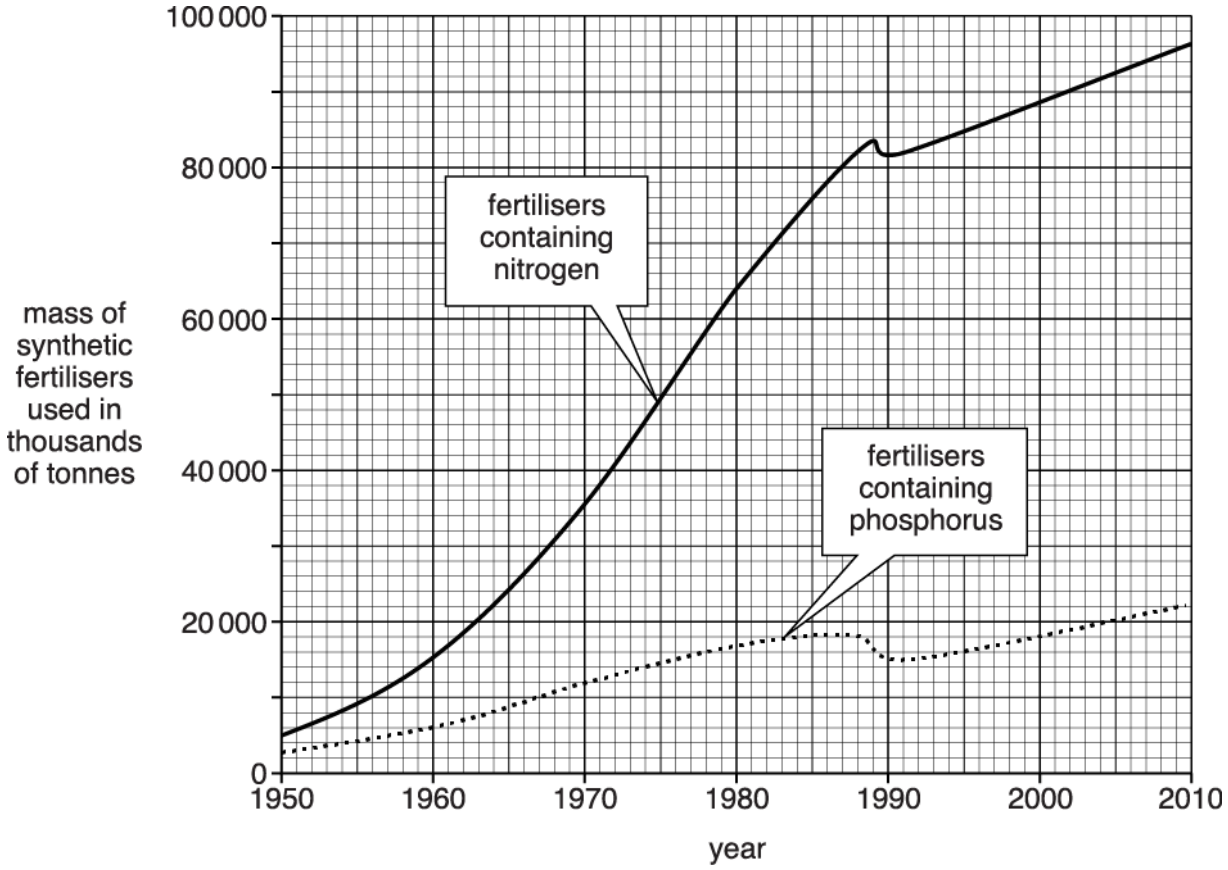
(b) Look at the graph.

It shows the use of synthetic fertilisers in the world between the years 1950 and 2010.

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Use the graphs in **(a)** and **(b)** to **compare** the use of synthetic fertilisers in the UK and the world.

---[3]

(c) Farmers also use **pesticides** to increase crop yield.

Pesticides kill pests such as insects which eat the crops.

Look at the table. It shows the use of synthetic fertilisers and pesticides in some countries.

Country	Mass of synthetic fertilisers used in 1 km^2 in kg	Mass of pesticides used in 1 km^2 in kg
A	39000	5100
B	59000	200
C	45000	900
D	8000	500
E	6000	200

(i) Some people want to buy organic vegetables.

Organic vegetables must be grown **without** the use of synthetic fertilisers and pesticides.

From the information in the table, suggest a country, **A, B, C, D** or **E** which grows lots of organic vegetables.

Explain your answer.

---

[2]

(ii) The land area of country **B** is 7 000 000 km^2.

Calculate the mass of **pesticides** used in country **B**.

---

mass of pesticides = _____ kg **[1]**

(d) The use of synthetic fertilisers also contributes towards the greenhouse effect.

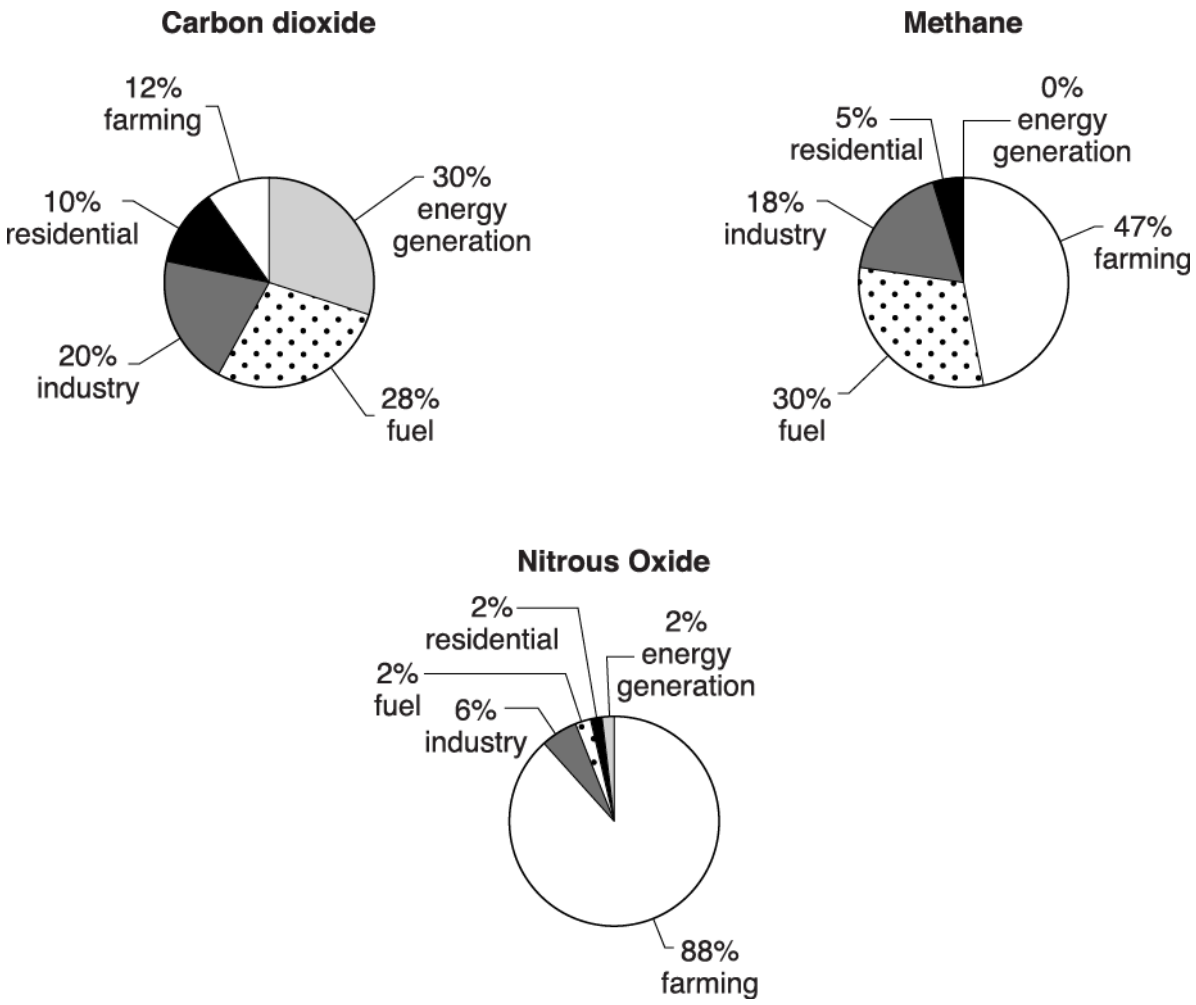
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Look at the pie charts about three greenhouse gases.

They show where these greenhouse gases come from.



Suggest which gas is most likely to be made from the use of synthetic fertilisers.

Choose from carbon dioxide, methane or nitrous oxide.

How can you tell?

---

[2]

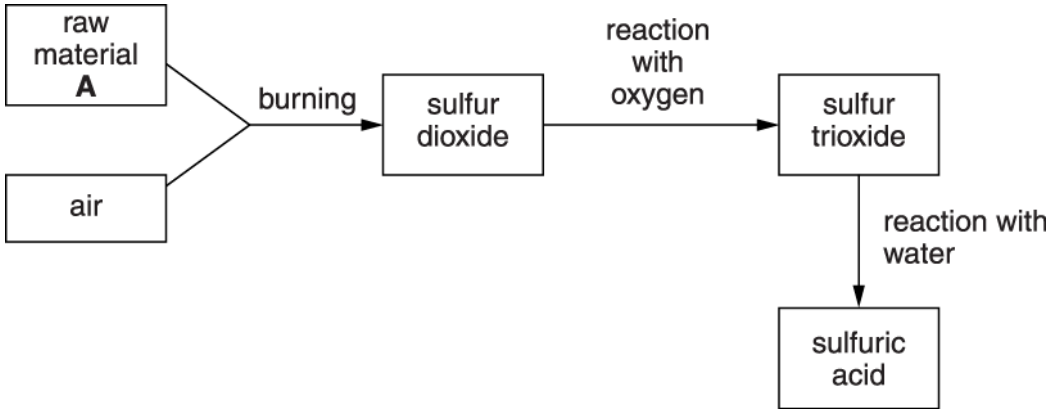
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11 This question is about the Contact Process used for the manufacture of sulfuric acid.

Look at the flow chart for the process.



What is the name of raw material **A**?

[1]

12 Farmers use fertilisers to improve crop yield.

Fertilisers contain one or more of the three essential elements.

These essential elements are nitrogen, phosphorus and potassium.

Fertilisers made in factories are called **synthetic** fertilisers.

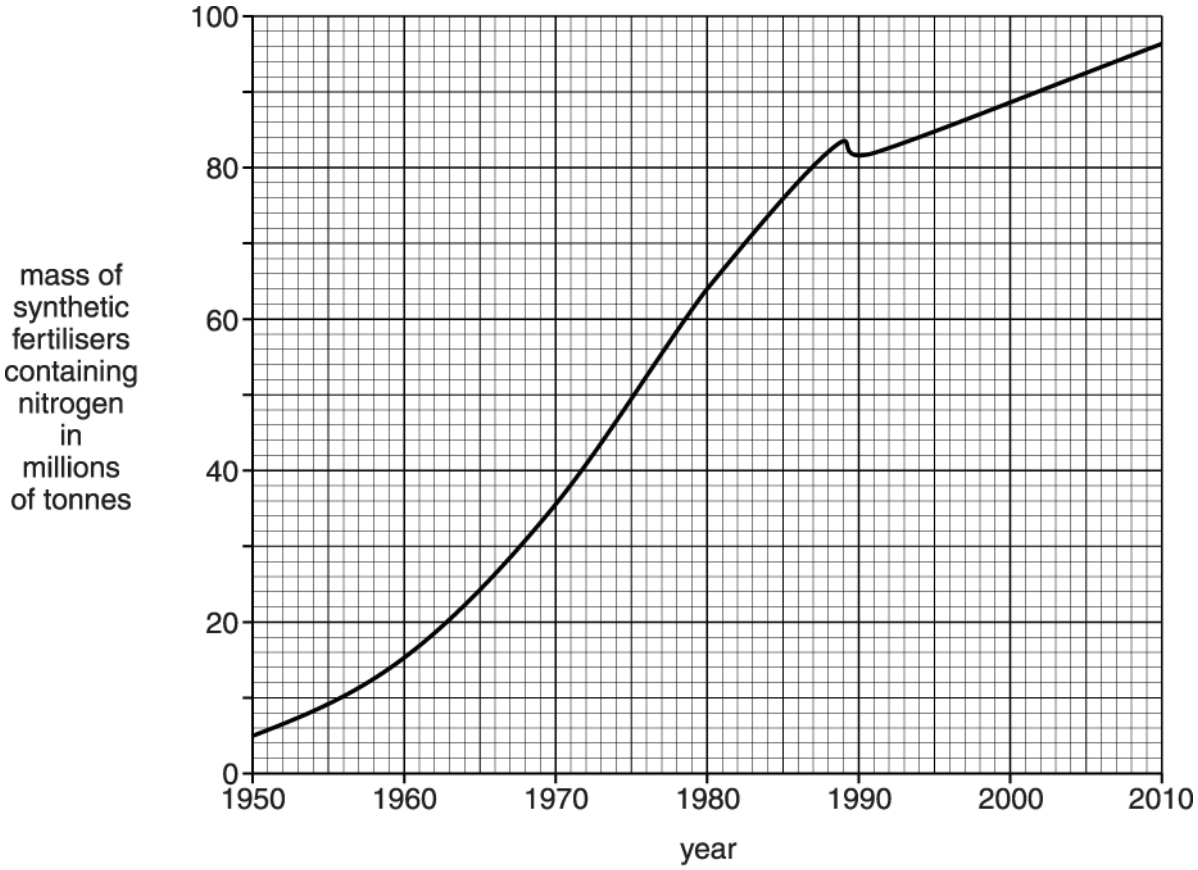
Look at **Graph 1**.

It shows the world use of synthetic fertilisers containing nitrogen between the years 1950 and 2010.

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Graph 1

(i) What mass of fertilisers containing nitrogen was used in 1970?

mass = _____ millions of tonnes

[1]

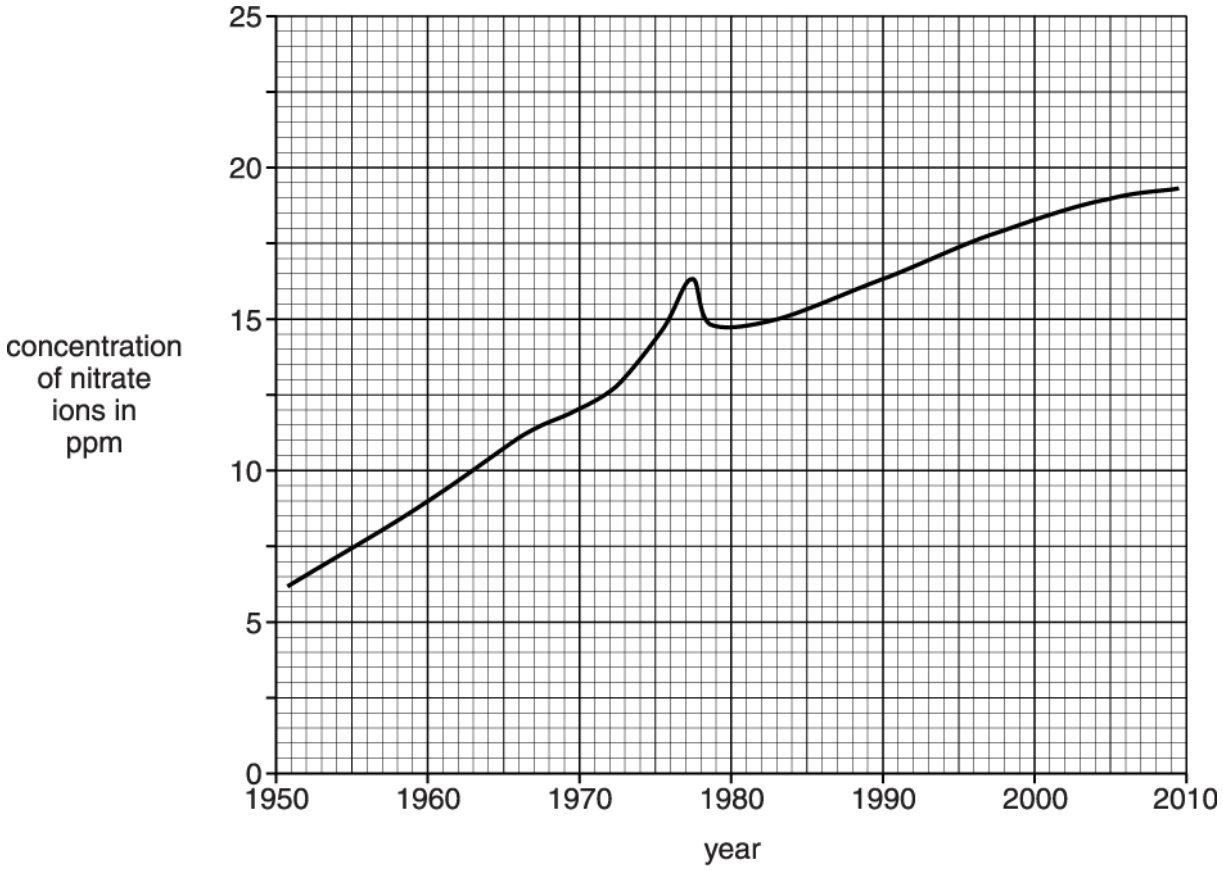
(ii) Look at **Graph 2**.

It shows the concentration of nitrate ions, NO_3^-, from fertilisers in the River Rhine between the years 1950 and 2010.

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Graph 2

Pollution controls were introduced for the River Rhine in 1977 to reduce nitrate, NO_3^-, concentrations.

What evidence is there from **Graph 2** that these controls have been effective?

---

[1]

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13(a) Farmers also use **pesticides** to increase crop yield.

Pesticides kill pests such as insects which eat the crops.

Look at the table. It shows the use of synthetic fertilisers and pesticides in some countries.

Country	Mass of synthetic fertilisers used in 1 km^2 of agricultural land in kg	Mass of pesticides used in 1 km^2 of agricultural land in kg	Percentage of land area available for agriculture (%)
A	26000	66	61
B	963000	128000	4
C	62000	1400	34
D	67000	740	34
E	330000	1000	18

(i) The agricultural land area of country **E** is 1 260 000 km^2.

Calculate the mass of **pesticides** used in country **E**.

mass of pesticides = _____ kg

[1]

(ii) Country **B** uses much more synthetic fertiliser and pesticides per km^2 than country A.

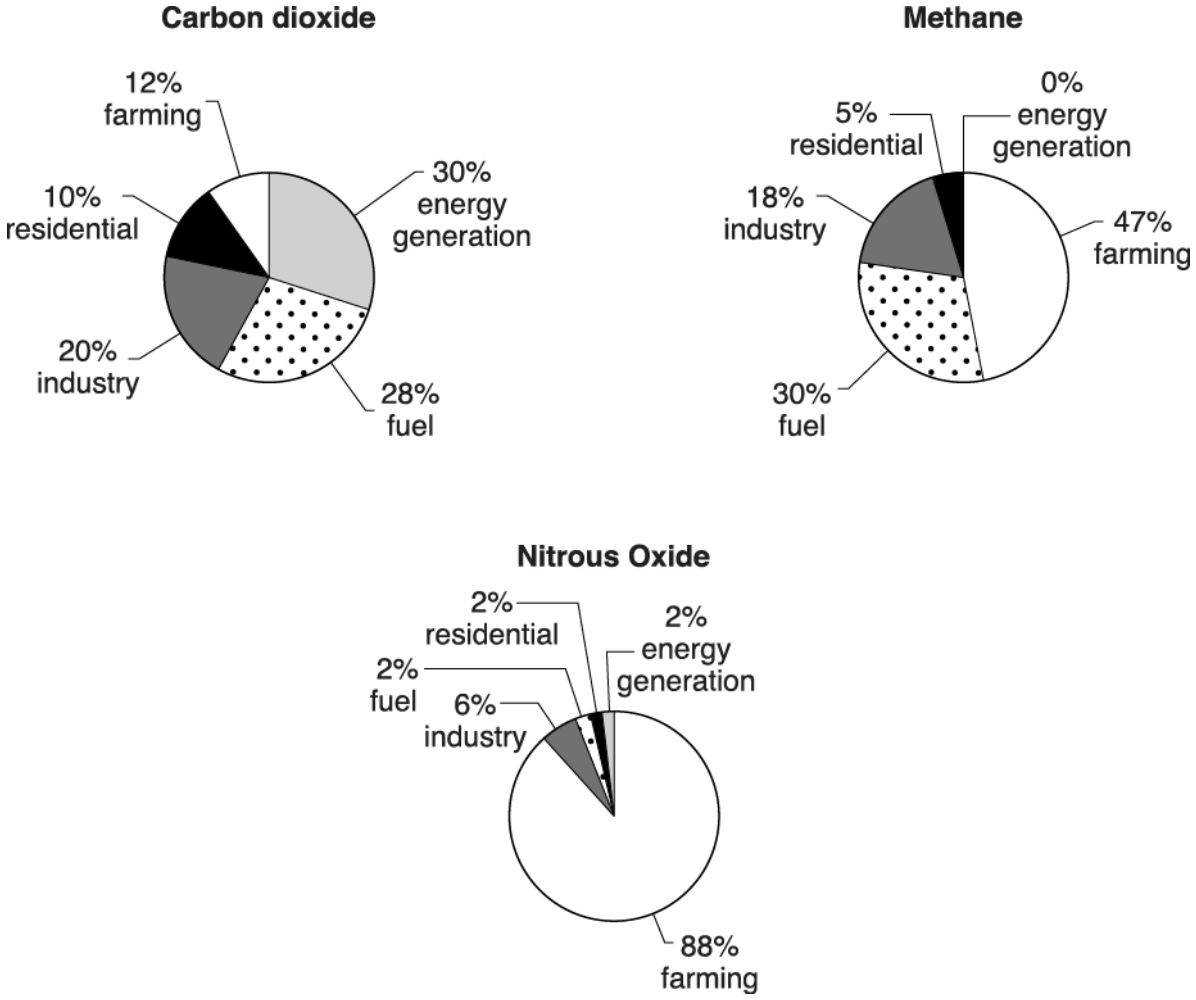
Suggest why. Use information from the table.

[2]

(b) The use of synthetic fertilisers also contributes towards the greenhouse effect.

Look at the pie charts about three greenhouse gases.

They show where these greenhouse gases come from.



(i) Suggest which gas is most likely to be made from the use of synthetic fertilisers.

Choose from carbon dioxide, methane or nitrous oxide.

How can you tell?

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--- [2]

(ii) Farming has a bigger contribution towards the greenhouse effect than residential use.

Use the information in the pie charts to support this statement.

--- [3]

14 This question is about making ammonia by the Haber process.

Nitrogen and hydrogen react to make ammonia.

(i) The hydrogen gas used to make ammonia comes from natural gas.

Where does the **nitrogen gas** come from?

Choose from the list.

air

limestone

salt

water

--- [1]

(ii) Nitrogen and hydrogen react to make ammonia.

Not all of the nitrogen and hydrogen reacts.

What happens to the unreacted nitrogen and hydrogen?

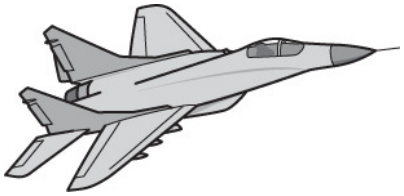
--- [1]

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15 Look at the table. It gives information about the properties of some metals.

Metal	Melting point in °C	Density in g/cm^3	Relative strength (1 = weak, 10 = strong)	Relative heat conductivity (1 = low, 10 = high)	Cost per tonne in £
A	1660	4.5	6.4	8.6	5000
B	420	7.1	4.3	9.0	870
C	1535	7.9	8.2	7.3	400

Look at the picture of a military aircraft. Only small numbers of these aircraft are made.



Evaluate the advantages and disadvantages of each metal for making the **body** and **wings** of this military aircraft. Which metal, **A**, **B** or **C**, would you choose and why?

The quality of written communication will be assessed in your answer to this question.

[6]

16 Fertilisers can cause **eutrophication**.

Explain what happens during eutrophication.

[3]

17 Jill wants to buy a sports jacket that she can wear **in all weathers**.

Look at the information about polymers **A**, **B**, **C**, **D** and **E**.

Polymer	Is it stiff or flexible?	Is it waterproof?	Is it breathable?
A	stiff	no	yes
B	flexible	no	yes
C	flexible	yes	yes
D	stiff	yes	yes
E	flexible	yes	no

Which polymer would be best for making Jill's sports jacket?

Explain your choice.

[2]

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18 One cost in making ethanol is the cost of heating the equipment to 300 °C and generating a pressure of 70 atmospheres.

Write about the **other** costs involved.

[2]

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19 Look at the table. It gives information about the properties of some metals.

Metal	Melting point in °C	Density in g/cm^3	Relative strength (1 = weak, 10 = strong)	Relative heat conductivity (1 = low, 10 = high)
A	1083	8.9	4.8	9.5
B	1660	4.5	6.4	8.6
C	420	7.1	4.3	9.0
D	1535	7.9	8.2	7.3

Look at the picture of an aircraft.



What properties of a metal would make it suitable for making the **body** and **wings** of this aircraft?

Which metal, **A**, **B**, **C** or **D**, would you choose and why?

The quality of written communication will be assessed in your answer to this question.

[6]

20 Many fertilisers are made by neutralisation.

Write about one **benefit** and one **problem** caused by using fertilisers.

---

[2]

21 This question is about polymers.

Jill wants to buy a sports jacket that she can wear **in all weathers**.

Look at the information about polymers **A**, **B**, **C**, **D** and **E**.

Polymer	Is it stiff or flexible?	Is it waterproof?	Is it breathable?
A	stiff	no	yes
B	flexible	no	yes
C	flexible	yes	yes
D	stiff	yes	yes
E	flexible	yes	no

Which polymer would be best for making Jill's sports jacket?

Explain your choice.

---

[2]

22(a) Nick is investigating the rusting of iron.

He wants to find out the best way of stopping iron from rusting.

He treats iron in different ways.

He leaves them in a damp place and sees how long it takes for the first signs of rust to appear.

Look at Nick's results.

Type of treatment	Time for rust to appear in days
untreated iron (no treatment)	1
painted iron	10
iron mixed with chromium (alloying)	120
iron coated in zinc (galvanised)	50
iron covered in oil	5

Nick included the results for a piece of untreated iron.

Suggest why.

---

[1]

(b) Put the methods of preventing rusting in order of their effectiveness, with the most effective first.

Explain how you decided the order and describe how painting iron protects it from rusting.

The quality of written communication will be assessed in your answer to this question.

[6]

23 Nick is investigating ways of preventing iron from rusting.

He wants to protect the bottom of a ship.

The bottom of the ship is made from iron.



He treats samples of iron in different ways.

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He leaves them in a damp place and sees how long it takes for the first signs of rust to appear.

Look at Nick's results.

Type of treatment	Time for rust to appear in days	Cost of treatment in £ per tonne of iron
untreated iron (no treatment)	1	
painted iron	10	100
iron mixed with chromium (alloying)	120	1000
iron with blocks of magnesium attached	50	500

Evaluate the **advantages** and **disadvantages** of each type of treatment for protecting the bottom of the ship from rusting.

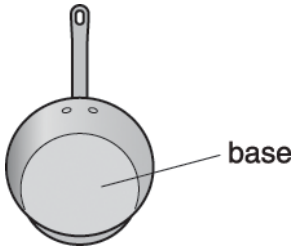
Explain how attaching blocks of magnesium helps to prevent rusting.

The quality of written communication will be assessed in your answer to this question.

[6]

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24 Kylie is choosing a metal to make a base for a saucepan.



Look at the information about some metals.

Metal	Melting point in °C	Relative electrical conductivity (1 = low, 10 = high)	Relative conductivity of heat (1 = low, 25 = high)	Density in g / cm^3
A	1535	1	4.2	7.9
B	98	2	7.8	1.0
C	1083	6	22.3	8.9
D	660	4	11.8	2.7

Which metal should Kylie choose to make a base for a saucepan?

Explain your answer.

--- [2]

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25 Ethanol is also made by fermentation of sugars in a batch process.

The table compares making ethanol by hydration and by fermentation.

	Hydration	Fermentation
Raw materials	ethene from crude oil	sugar from plants
Type of process	continuous	batch
Rate of reaction	fast	slow
Conditions used	high temperature, 300 °C, high pressure, 60 atm, and a catalyst	low temperature, 40 °C, atmospheric pressure and an enzyme in yeast acts as a catalyst
Purity of product	pure	impure
Atom economy	100%	51%

Evaluate the advantages and disadvantages of each method.

Which method do you think is the best for manufacturing ethanol in the UK?

Explain why.



The quality of written communication will be assessed in your answer to this question.

[6]

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26(a) Look at the table.

It shows information about the contents of some foods on food labels.

It also shows the Guideline Daily Amounts (GDA) for an adult.

Food contents	Small pizza	Chicken curry	Fish in cheese sauce	GDA for an adult
Energy in calories	396	384	200	2000
Protein in g	16.9	41.4	22.8	45
Carbohydrate in g	51.3	11.0	2.9	230
Fat in g	13.7	19.2	10.8	70
Sodium in g	0.7	0.9	0.4	2.3

Look at the information for the chicken curry.

What percentage of the GDA for **fat** is in the chicken curry?

answer _____ %

[2]

(b) The chicken curry contains 1.17 g of salt.
Salt is sodium chloride, NaCl.

(i) Calculate the mass of sodium in 1.17 g of salt.

Give your answer correct to **2 significant figures**.

The relative atomic mass, A_r, of Na is 23 and of Cl is 35.5.

answer _____ g

[1]

(ii) Why is the value that you calculated in part (i) less than the value in the table?

_____

_____ **[1]**

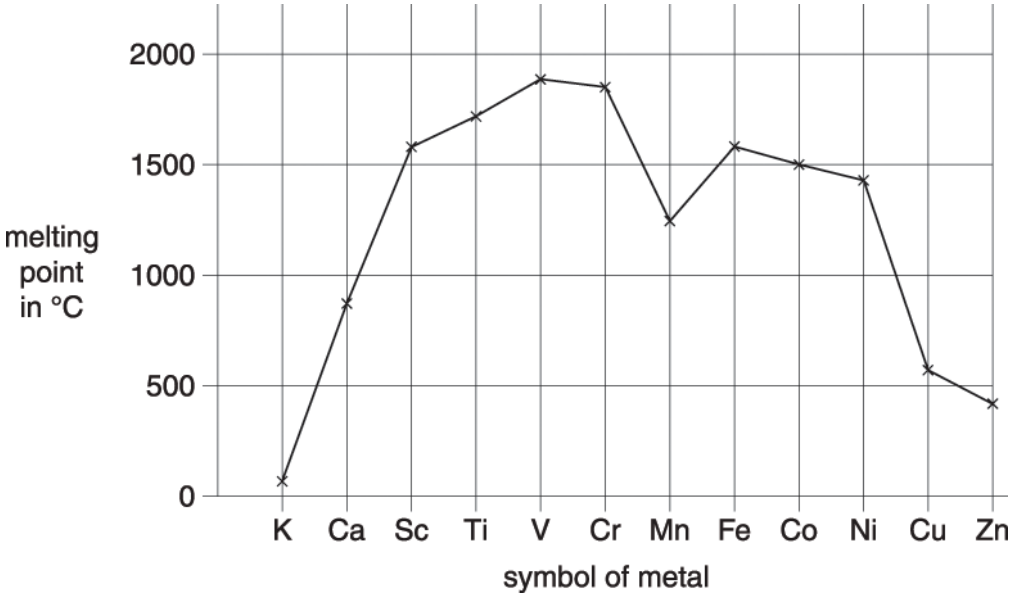
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27 Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.



Write the symbol of the metal which has the **weakest** metallic bonds.

---

[1]

28 Joe wants to remove paint marks from his clothes.

Look at the table. It shows information about different solvents.

Solvent	Does it remove blue paint?	Does it remove red paint?	Does it remove yellow paint?	Does it damage the clothes?
A	yes	yes	no	no
B	no	no	yes	yes
C	no	yes	yes	yes
D	no	yes	yes	no

Joe wants to remove blue and yellow paint from his clothes without damaging them.

Joe thinks he can use **one or more** of these solvents to do this.

Is Joe right? _____

Explain your answer.

_____

_____

_____

_____ [2]

29(a) This question is about the rusting of iron.

Which **two** substances are needed for iron to rust?

_____ and _____ [2]

(b) Write about **two** methods that can be used to stop iron from rusting.

Explain how **one** of the methods works.

_____

_____

_____

_____

_____ [3]

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30 Joe wants to wash his clothes.

He looks at the label on the washing powder.

The label shows some of the ingredients in the washing powder.

Match each ingredient to its job.

Draw only three straight lines.

ingredient	job
active detergent	removes food stains
optical brightener	does the cleaning
enzymes	gives a 'whiter than white' appearance

[2]

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31 This question is about metals.

Phil wants to buy a new bicycle.



He uses the internet to research which metal is the most suitable for making the bicycle frame.

Look at the table.

It shows the information he finds out.

Metal	Density in g/cm^3	Relative strength (1= low, 10 = high)	Resistance to corrosion	Cost per tonne in ☐
aluminium	2.7	0.9	very good	2220
copper	8.9	2.1	good	5550
stainless steel	7.8	7.3	very good	900
titanium	4.5	10	very good	17000

Which metal is the most suitable for making Phil's bicycle frame?

_____

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Explain your answer using information from the table.

---[3]

32(a) Ammonium sulfate is made by reacting an acid with an alkali.

Name the acid and alkali needed.

Describe how the acid and alkali are used to make a sample of ammonium sulfate.

---[3]

(b) Nitric acid is used to manufacture fertilisers.

Ammonia, NH_3, and oxygen, O_2 are used to manufacture nitric acid, HNO_3.

Water is the other product.

The reaction between ammonia and oxygen uses the following conditions:

- a temperature of 900°C
- atmospheric pressure
- a platinum catalyst.

Construct the **balanced symbol** equation for the manufacture of nitric acid and explain the **advantages** and **disadvantages** of using these conditions.



The quality of written communication will be assessed in your answer to this question.

---

[6]

33(a) Many different materials are needed to build a car.



(i) Suggest a property of glass that makes it useful for making a car windscreen.

---

[1]

(ii) Some car bodies are now built from aluminium instead of steel.

One advantage of using aluminium is that it is less dense than steel.

Write down **one other advantage** of building car bodies from aluminium instead of steel.

---

[1]

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(b) Look at the table.

It shows information about some of the materials used to build a car.

Material	Density in g/cm^3	Electrical conductivity	Flexibility
aluminium	2.7	very high	low
glass	2.5	very low	low
PVC	1.4	very low	high
steel	7.8	high	low

Explain why PVC is used for covering the electrical wires in a car.

Use the information from the table.

---[2]

34 Magnesium sulfate and magnesium nitrate are both used as fertilisers.

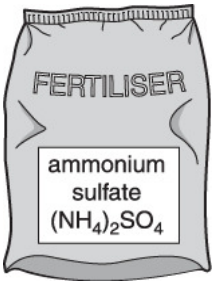
Magnesium sulfate can be made in industry by a **continuous** process.

Explain why batch processes are used to make some pharmaceutical drugs but continuous processes are used to make fertilisers.

---[2]

35(a) This question is about fertilisers.

Ammonium sulfate is used as a fertiliser.



The formula for ammonium sulfate is $(NH_4)_2SO_4$.

(i) Write down the number of **different elements** in ammonium sulfate.

answer _____

[1]

(ii) Write down the number of **atoms** in this formula.

answer _____

[1]

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(b) Amy and Chris decide to make **some solid ammonium sulfate** by neutralisation.

They use an acid and an alkali.

Name the acid and alkali they use and describe the experimental method they use.

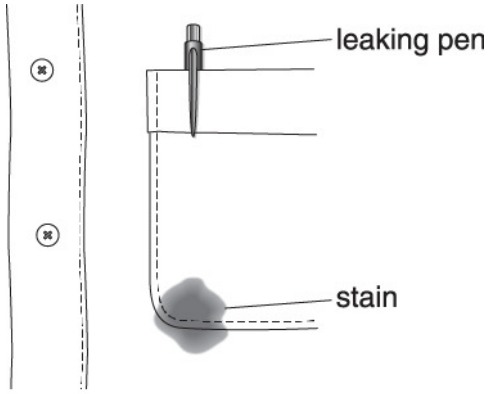
The quality of written communication will be assessed in your answer to this question.

---

[6]

36(a) Chemicals called esters can be used as **solvents**.

Sarah investigates how good four different solvents are at removing a stain from cotton.



Look at her results.

Solvent	Percentage of stain removed		Effect on cotton
	At 40°C	At 60°C	
A	0%	35%	colour fades
B	10%	60%	none
C	85%	100%	cotton shrinks
D	75%	95%	none

Which solvent is the most suitable for removing stains from cotton?

_____

Explain your choice.

_____

_____

_____ [2]

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(b) Sarah thinks her results do not provide sufficient evidence to make a firm conclusion.

Explain what further tests would help to make her conclusion more secure.

---

[2]

37 A pharmaceutical drug is made by a batch process.

Write about **three** factors that affect the **cost** of making a pharmaceutical drug.

---

[3]

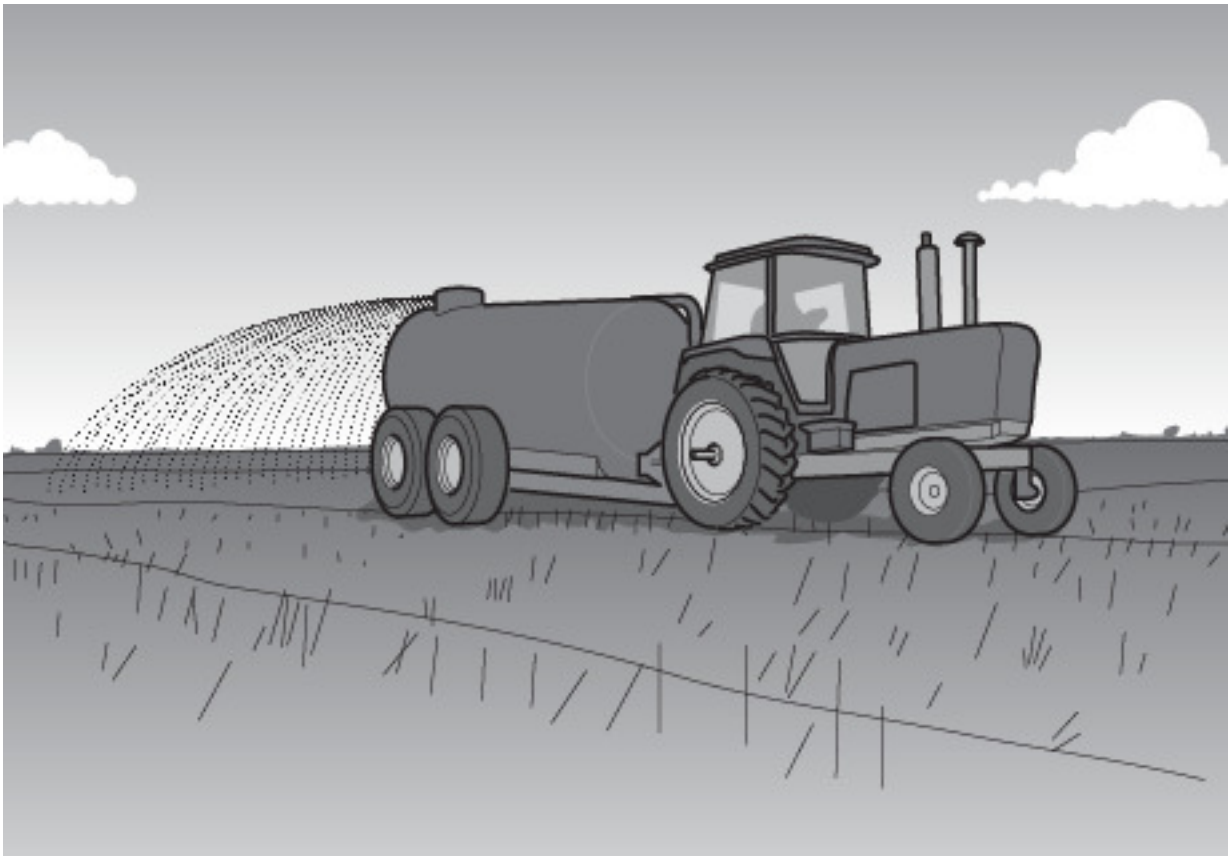
38(a) This question is about fertilisers.

Farmers add fertilisers to the soil.

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What part of a plant absorbs the minerals from the fertilisers?

---

[1]

(b) Ammonium phosphate, $(NH_4)_3PO_4$, is a fertiliser.



(i) Complete the table to show the number of each **type of atom** in the formula $(NH_4)_3PO_4$.

Atom	Number
N	_____
H	_____
P	_____
O	_____

[2]

(ii) Write down the **names** of the **two** essential elements in ammonium phosphate.

_____

_____ **[2]**

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(c) Ammonium phosphate solution is made by reacting an acid with an alkali in a neutralisation reaction.

Write down the name of the **acid** and the **alkali** needed to make ammonium phosphate.

Describe how an indicator can be used to check the **pH** of the solution made.



The quality of written communication will be assessed in your answer to this question.

---

[6]

39 Martin investigates the corrosion of different metals.

He places strips of metals in some damp gases.

Look at his results.

Metal	Appearance at start	Appearance after two weeks in damp ...		
		... oxygen	... acidic air	... nitrogen
copper	shiny pink	small patches of green on surface	thick green layer on surface	shiny pink
iron	shiny silver	small patches of brown on surface	lots of brown flakes on surface	shiny silver
lead	shiny silver	dull silver	black layer on surface	shiny silver

Martin concludes that:

- oxygen is needed for corrosion
- more corrosion happens in acidic air than in any of the other conditions.

Is he correct? _____

How can you tell? Write down evidence from the table in your answer.

_____

_____

_____

_____ [2]

40 Concrete is a building material.

Concrete is made stronger using a steel support.

This is called **reinforced concrete**.

Look at the table.

It gives some information about three types of steel.

Type of steel	Iron alloyed with	Relative strength	Other properties
A	about 0.25% carbon	386	easily shaped
B	up to 2.5% carbon	414	hard, more difficult to shape
C	chromium and nickel	515	easily shaped, resistant to corrosion

(i) Steel **C** is the best choice for reinforcing concrete.

Use information from the table to give **two** reasons why.

---

[2]

(ii) The three types of steel in the table are **alloys**.

What is meant by an alloy?

---

[1]

41(a) Some foods contain additives.

Flavour enhancers improve the flavour of a food.

An emulsifier stops oil and water in a food from separating.

Write down the name of **another** food additive.

Describe the job of this food additive.

name of food additive _____

job of the additive _____

_____ [2]

(b) Phil finds some information about four emulsifiers.

Look at this information.

Emulsifier	Is it poisonous?	Does it have a smell?	Cost of making 1g of emulsifier in pence
A	yes	no	3
B	yes	no	6
C	no	no	1
D	no	yes	5

Which emulsifier is the most suitable to be used in a food?

Explain your answer.

_____

_____

_____

_____ [3]

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42 Stowmarket Synthetics make a polymer that is used to make bottles for fizzy drinks.



The polymer used to make the bottles is **non-biodegradable**.

Some scientists want the polymer to be **biodegradable**.

What is a **biodegradable** polymer?

Write about the advantages and disadvantages of using a **biodegradable** polymer to make these bottles.

The quality of written communication will be assessed in your answer to this question.

[6]

43 There are many costs in making ammonia.

One of these is the cost of energy (gas and electricity).

Write about some of the other **costs** of making ammonia.

[3]

44 **Recycling** copper is cheaper than extracting copper from its ore.

Explain why.

[2]

45 This question is about metals.

Look at the table. It shows some properties of three metals.

	Density in g/cm^3	Relative electrical conductivity (0 = low, 100 = high)	Relative strength (0 = weak, 1000 = very strong)	Corrosion in moist air	Cost per tonne in £
Aluminium	2.7	40	300	does not corrode	770
Copper	8.9	64	400	corrodes slowly	5900
Iron	7.9	11	600	corrodes	200

Look at the picture. It shows overhead power cables used by electric trains.

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Suggest what **properties** are needed by a metal used to make the overhead power cables.

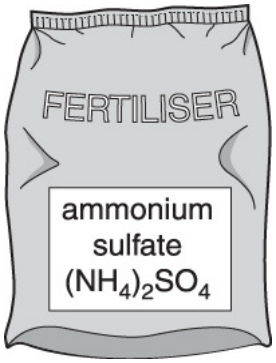
Which metal in the table would you use and why?

The quality of written communication will be assessed in your answer to this question.

[6]

46(a) This question is about fertilisers.

Ammonium sulfate is used as a fertiliser.



The formula for ammonium sulfate is $(NH_4)_2SO_4$.

(i) Write down the number of **different elements** in ammonium sulfate.

answer _____

[1]

(ii) Write down the number of **atoms** in this formula.

answer _____

[1]

(b) Chloe makes some ammonium sulfate.

The alkali she uses is ammonia solution.

Which **acid** does she use?

_____ **[1]**

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(c) Write about one **benefit** and one **problem** of using fertilisers.

---

[2]

47 Sarah investigates four different solvents.

She wants to know how well they remove a stain.

Look at her results.

Solvent	Percentage of stain removed	
	At 40°C	At 60°C
A	0%	35%
B	10%	60%
C	85%	100%
D	75%	95%

(i) Which solvent is best at removing the stain?

answer _____

[1]

(ii) Sarah decides that the solvents work better at a higher temperature.

How can you tell from Sarah's results?

---

[1]

48 Different polymers have different properties.

The uses of a polymer depend on its properties.

Look at the table. It compares the properties of three polymers, **A**, **B** and **C**.

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	Density in g/cm^3	Maximum useable temperature in °C	Strength in MPa (1 = weak, 10 = strong)	Relative flexibility
polymer **A**	0.92	85	1	flexible
polymer **B**	0.95	120	9	stiff
polymer **C**	0.89	25	2	stiff

Which polymer would you choose to make outdoor garden furniture?



polymer _____

Explain your choice.

_____

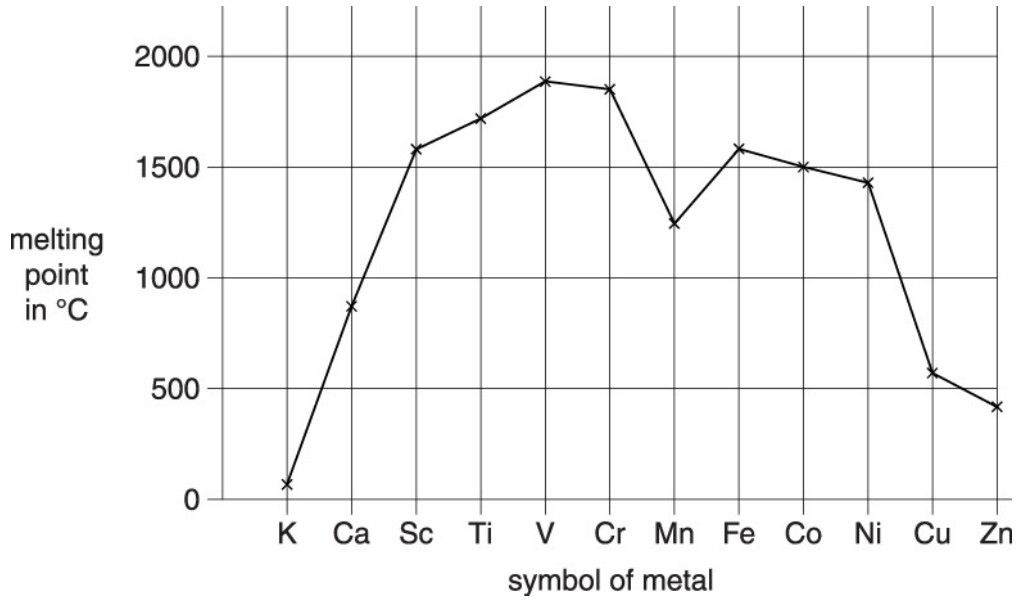
_____

_____

_____ [3]

49 Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.



Write the **symbol** of a metal that can be used to make a container to melt iron.

Explain your answer.

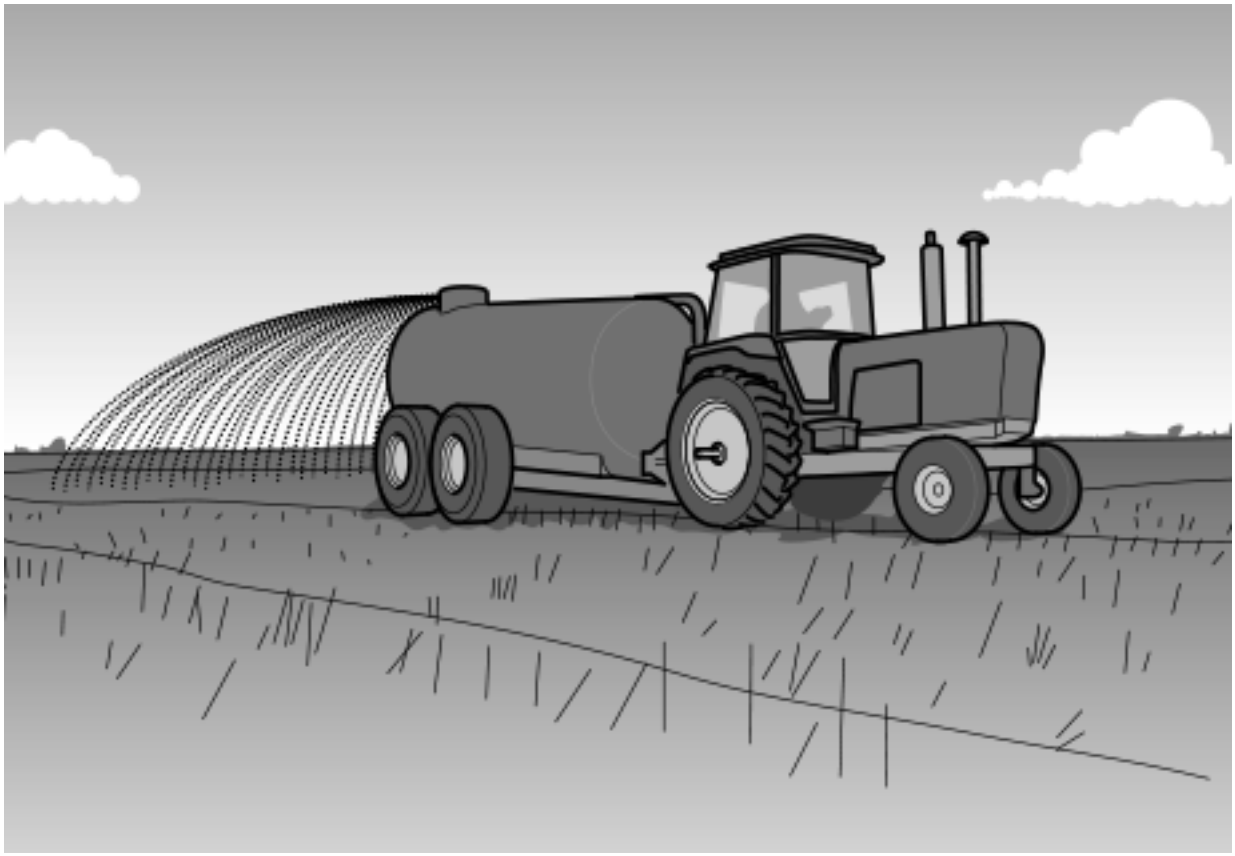
---

[2]

50(a) This question is about fertilisers.

Farmers add fertilisers to the soil.

Some people think that farmers should not use fertilisers.



Write down a reason **for** and a reason **against** the use of fertilisers.

---

[2]

(b) Ammonium phosphate, $(NH_4)_3PO_4$, is a fertiliser.



(i) Complete the table to show the number of each **type of atom** in the formula $(NH_4)_3PO_4$.

Atom	Number
N	----------
H	----------
P	----------
O	----------

[2]

(ii) Ammonium phosphate solution is made by reacting an acid with an alkali in a **neutralisation** reaction.

Describe how pure, dry crystals of ammonium phosphate can be made, including the names of the **acid** and **alkali** needed.

The quality of written communication will be assessed in your answer to this question.

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---[6]

51 Martin investigates the corrosion of different metals and alloys.

He places pieces of the metals or alloys in different concentrations of sulfuric acid.

He does his experiment at three different temperatures.

Look at his results.

Temperature in °C	Sulfuric acid concentration in %	Resistance to corrosion		
		Niobium	Zirconium	Hastelloy
20	10	excellent	excellent	poor
	40	excellent	excellent	good
	70	excellent	excellent	excellent
	90	good	poor	excellent
40	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	excellent	poor
	90	poor	poor	poor
60	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	good	poor
	90	poor	poor	poor

Martin concludes that:

- all three metals or alloys are more resistant to corrosion at lower concentrations of sulfuric acid
- all three metals or alloys are more resistant to corrosion at lower temperatures.

Is he correct?

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Use information from the table to explain your answer.

---[2]

52 Concrete is a construction material.

Concrete is quite strong.

It is reinforced using a mesh of steel rods.

This is called **reinforced concrete**.

(i) Reinforced concrete is a better construction material for making bridges than non-reinforced concrete.

Explain why.

---

[2]

(ii) Look at the table.

It gives some information about three types of steel used to reinforce concrete.

Type of steel	Relative strength	Density in g / cm^3	Cost of 1 m × 2 m mesh	Resistance to corrosion	Other properties
A	386	7.85	£26.99	limited	easily shaped
B	414	7.90	£40.35	limited	hard, more difficult to shape
C	515	7.80	£50.52	very good	easily shaped

Which type of steel would be best to reinforce concrete?

Use information from the table to suggest why.

---

[2]

53 Trevor needs to store these four chemicals.



Trevor investigates different metals, **A**, **B**, **C** and **D**.

Look at the results of his investigation.

	Rate of corrosion of metal by chemical (1 = very slow, 3 = fast)			
	Metal A	Metal B	Metal C	Metal D
chlorine gas	1	2	3	3
hydrogen gas	1	1	1	1
sodium chloride	3	1	1	2
sodium hydroxide	1	3	1	2

Trevor concludes that he **cannot** use the same metal to make the container for each chemical.

Do you think that Trevor has made the correct conclusion? _____

Explain your answer using the evidence in the table.

---

[2]

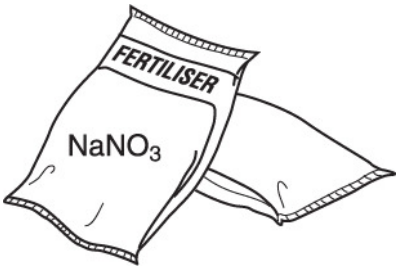
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54(a) This question is about fertilisers.

Fertilisers are chemicals that provide plants with **essential elements**.



Sodium nitrate, $NaNO_3$, is a fertiliser.

Write down the **name** of the essential element for plant growth found in sodium nitrate.

---

[1]

(b) Ammonium sulfate is another fertiliser.

Ammonium sulfate is made by reacting an acid with an alkali.

Write down the name of the **acid** used to make ammonium sulfate.

---

[1]

(c) Fertilisers can be **beneficial** but may also cause **problems**.

Write about the benefits and problems of using fertilisers.

---

[2]

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(d) Nitric acid is used to make fertilisers.

Ammonia and oxygen are used to manufacture nitric acid.

Water is the other product.

Write the **word equation** for this process and describe **costs** of making nitric acid.

The quality of written communication will be assessed in your answer to this question.

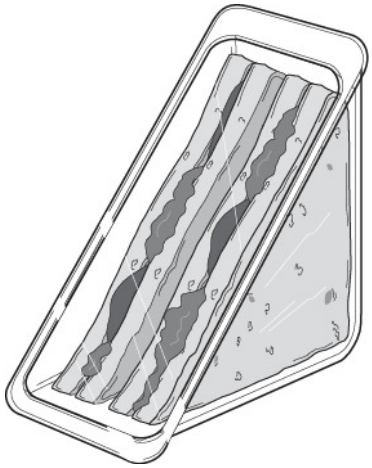
---

[6]

55(a) Anna buys sandwiches from a shop.

The sandwiches are in plastic packaging.

The plastic is made from a polymer called poly(propene).



Two properties of poly(propene) are:

- it is non-biodegradable
- it is insoluble in water.

Explain why these two properties make poly(propene) suitable for making the packaging and suggest, with a reason, one **other** suitable property needed by poly(propene).

The quality of written communication will be assessed in your answer to this question.

[6]

(b) Anna finishes her sandwiches.

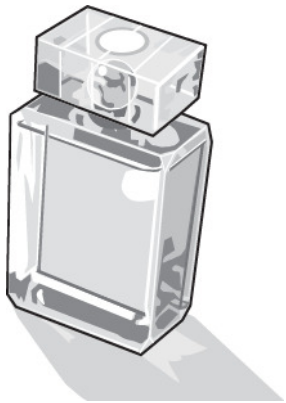
She throws the packaging into a dustbin.

Write about **two** ways the waste plastic from the dustbin is disposed of.

---

[2]

56(a) Stowmarket Synthetics make perfumes.



They make and test four new perfumes.

Perfumes must be tested before they are **permitted** to be used.

Write about **two** reasons why.

---

[2]

(b) Look at some of the properties of the four new perfumes.

Perfume	Boiling point in °C	Solubility in water (0 = insoluble and 10 = very soluble)
G	130	10
I	340	0
J	40	0
K	50	5

(i) Which perfume has the best set of properties?

_____

Write down **two** reasons for your choice of perfume.

_____

_____

_____

_____ [2]

(ii) Richard works for Stowmarket Synthetics.

He thinks there is not enough information in the table to decide which perfume should be manufactured.

He thinks the **cost** of making the perfume is important.

Write down one **other** piece of information that is important.

_____ [1]

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57 Most metals have these physical properties.

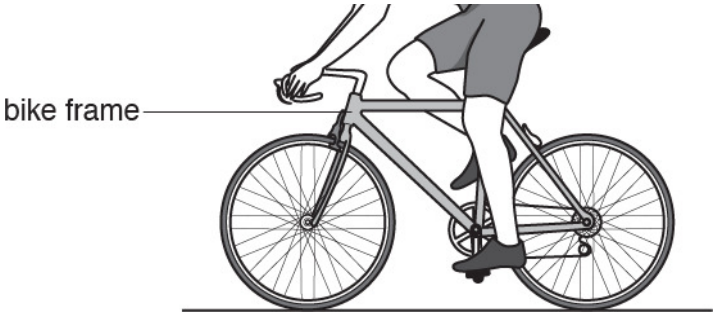
shiny

high melting point

high boiling point

Kevin builds a lightweight racing bike.

He chooses a suitable metal for the bike frame.



Suggest **three** properties, other than cost, needed by the metal he chooses.

---

[3]

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58 The table shows the main stages in the life-cycle assessment of a manufactured product.

Stage	Process
1	Manufacturing the product
2	Obtaining raw materials
3	Disposing of the product
4	Using the product

What is the correct order for the stages?

A 1, 2, 3, 4
B 1, 2, 4, 3
C 2, 1, 4, 3
D 2, 4, 1, 3

Your answer [ ] **[1]**

59 The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

What is the raw material for the **nitrogen**?

A Air
B Hydrochloric acid
C Natural gas
D Seawater

Your answer [ ] **[1]**

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60(a) This question is about the corrosion of metals.

A student investigates the rusting of iron.

Fig. 16.1 shows the experiments she sets up.

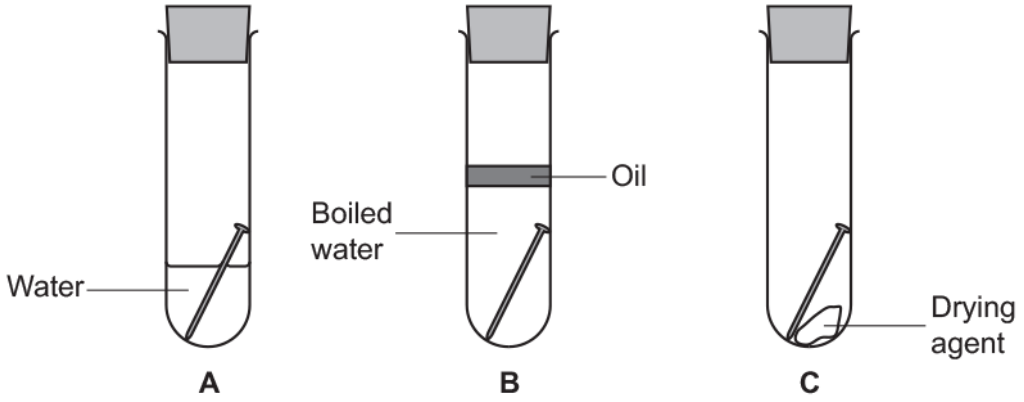


Fig. 16.1

Write about what the student would observe in each tube after one week.

Explain the observations.

Tube **A** ----------

Tube **B** ----------

Tube **C** ----------

---

[3]

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(b) Another student buys a new bicycle. The bicycle chain is made of iron.

The student decides to oil the chain to prevent it from rusting, as shown in **Fig. 16.2**.

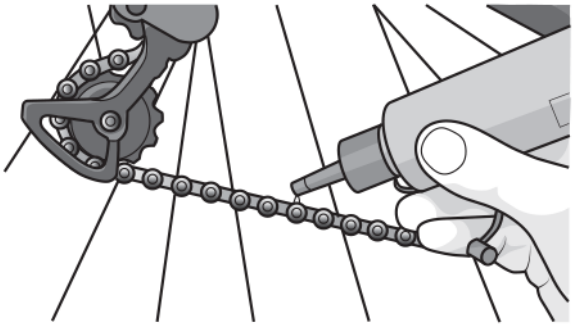


Fig. 16.2

Explain why oiling the chain will prevent the iron from rusting.

---

[2]

(c) A galvanised iron bucket is made of iron coated with a layer of zinc.

After years of use, the zinc coating has become scratched.

The iron below the zinc has been exposed but the iron has not rusted.

Explain why the iron has not rusted.

---

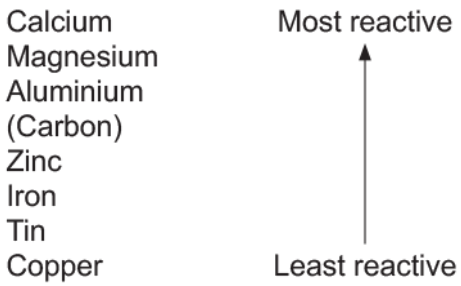
[2]

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61(a) Look at the reactivity series of some metals. Carbon is also included.



(i) Zinc is usually extracted from zinc oxide by **heating zinc oxide with carbon**.

Explain why. Use the reactivity series to help you.

[1]

(ii) Aluminium is extracted from aluminium oxide by **electrolysis**.

Explain why. Use the reactivity series to help you.

[1]

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(b) The table shows some information about aluminium and zinc.

Metal	Cost of 1 kg (£)	Amount in Earth's crust (%)
Aluminium	1.31	8.1
Zinc	2.51	0.0078

Suggest **two** reasons why it could be more important to recycle zinc than aluminium.

Use information from the table to help you.

1 _____

_____

2 _____

_____

[2]

(c) Aluminium alloys are often used to build aircraft.

A sample of an aluminium alloy contains 1.28 g of magnesium and 43.70 g of aluminium only.

Calculate the **percentage of magnesium** in this alloy.

Give your answer to **3** significant figures.

Percentage of magnesium = ... % **[4]**

62(a) Ammonia is used to make fertilisers.

Fertilisers usually contain nitrogen.

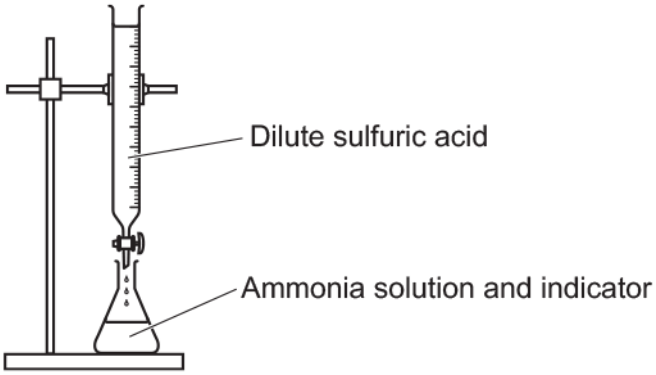
Name the **two** other elements that fertilisers usually contain.

---------- and ---------- **[2]**

(b) Ammonium sulfate is a salt used as a fertiliser.

Ammonium sulfate can be made in a laboratory in a batch process.

Ammonia solution is titrated with dilute sulfuric acid to make a solution of ammonium sulfate, as shown in the diagram.



Describe how you would make **dry crystals** of ammonium sulfate from ammonium sulfate solution.

---

[2]

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(c) Calcium sulfate is another salt.

A student made some calcium sulfate.

Look at the method he used:

- pour 100 cm^3 of calcium nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate appears
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid calcium sulfate onto a piece of filter paper.

Describe and explain **two** ways that the student could improve his method to **increase** the amount of **pure**, **dry** calcium sulfate made.

1 ---

---

2 ---

---

[4]

63 This question is about properties of materials.

Police bullet-resistant vests could be made from steel or Kevlar®.



The table shows some information about steel and Kevlar®.

	Steel	Kevlar®
Density (g / cm^3)	7.85	1.44
Relative strength	1	5
Flexibility	low	high
Resistance to corrosion	low	high

Describe and explain **two** reasons why bullet-resistant vests are made from Kevlar® instead of steel.

1 ----------

---

2 ----------

---

[4]

64 Phytoextraction is one way to extract copper from low-grade ores.

The table shows the main stages involved in phytoextraction.

Stage	Process
1	Copper ions accumulate in the roots, shoots and leaves of plants.
2	Copper is extracted from ash with a high concentration of copper compounds.
3	Plants absorb dissolved copper ions through their roots.
4	A crop is planted in soil containing low-grade copper ore.
5	Plants are harvested and burned.

What is the correct order for the stages?

A 1, 3, 4, 5, 2
B 4, 1, 3, 2, 5
C 4, 3, 1, 5, 2
D 1, 4, 3, 5, 2

Your answer ☐ **[1]**

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Describe and explain **two** reasons why bullet-resistant vests are made from Kevlar® instead of steel.

1 ---

---

2 ---

---

[4]

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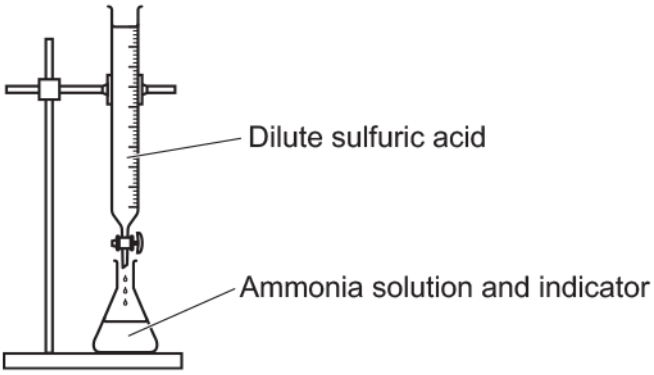
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66 Ammonia is used to make fertilisers such as ammonium sulfate.

A student makes some ammonium sulfate crystals in a laboratory.

She uses a titration method, as shown in the diagram.



She adds an indicator to ammonia solution in a conical flask. She then adds dilute sulfuric acid from a burette until the indicator changes colour.

The student then crystallises the solution. She is left with **impure** ammonium sulfate crystals.

(i) What should the student have done to obtain **pure** ammonium sulfate crystals?

---

[2]

(ii) In industry the same reaction is used to make ammonium sulfate.

The method used is different.

Give **one** reason why the laboratory method to make ammonium sulfate is **not** used in industry.

---

[1]

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67 Iron is a metal that rusts.

What conditions are needed for the rusting of iron?

A Air and an acid
B Air and salt
C Air and water
D Water and salt

Your answer [ ] [1]

68 Brass is an alloy.

What are the main metals in brass?

A Aluminium and copper
B Copper and iron
C Copper and tin
D Copper and zinc

Your answer [ ] [1]

69 Which of the following are three of the **essential elements** needed by plants?

A Carbon, nitrogen, oxygen
B Hydrogen, potassium, phosphorus
C Nitrogen, oxygen, potassium
D Nitrogen, phosphorus, potassium

Your answer [ ] [1]

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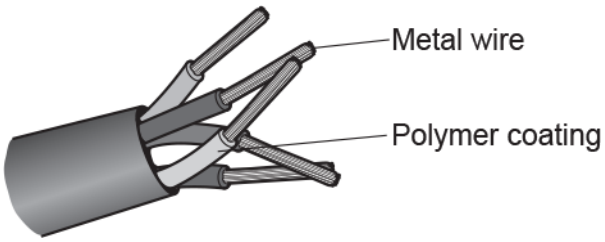
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70(a) This question is about the properties of materials.

Look at the table. It shows information about two materials.

	Polymer	Metal
Melting Point (°C)	100–260	1100
Density (kg / m^3)	940	8940
Relative electrical conductivity (10 = good, 1 = poor)	2	10
Flexibility	high	high

Electrical cables are made of metal wires surrounded by a polymer coating.



Explain why

- the wire is made of metal
- the metal wire is coated with a polymer.

Use information from the table in your answer.

[3]

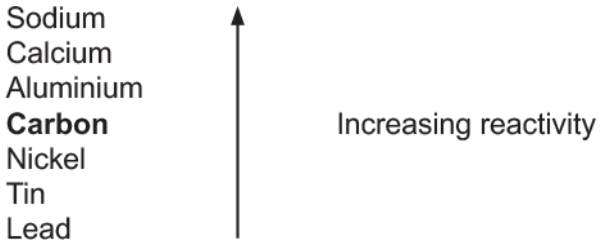
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(b) Aluminium is a metal.

Aluminium is extracted from an ore called bauxite.

Electrolysis is used to extract the aluminium.

Use the reactivity series to explain why aluminium cannot be extracted from bauxite by heating the bauxite with carbon.



[1]

(c) Drinks cans are often made from aluminium.

4.0 kg of bauxite makes 1.0 kg of aluminium.

285 000 kJ of energy is needed to make 1.0 kg of aluminium from bauxite.

Aluminium can be **recycled**.

4.0 kg of recycled aluminium makes 3.8 kg of aluminium.

14 250 kJ of energy is needed to produce 1.0 kg of aluminium from recycled aluminium.

(i) Describe how aluminium is recycled.

---

[2]

(ii) Describe and explain **two** advantages of recycling aluminium.

Use the information in the question in your answer.

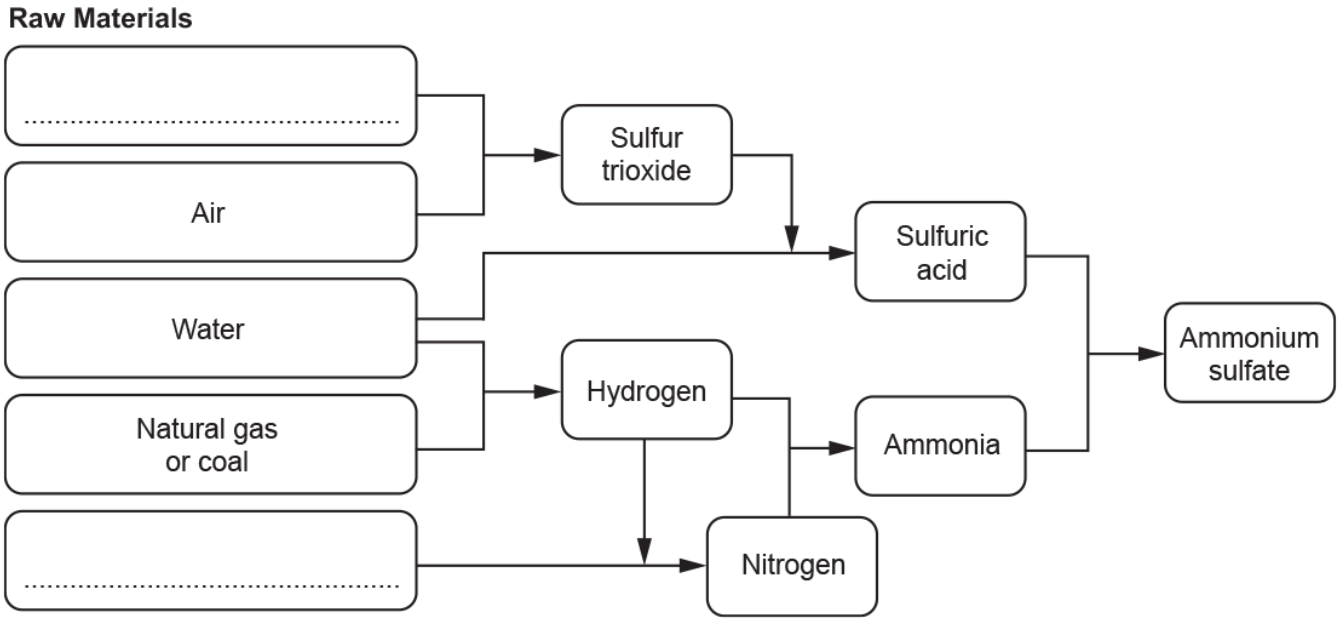
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[3]

71 Ammonium sulfate is a fertiliser made from ammonia and sulfuric acid.

The diagram shows the stages in the industrial production of ammonium sulfate.

Complete the diagram to show the **raw materials** in the production of ammonium sulfate.



[2]

72 The table shows some information about four alloys.

	Alloy	Main metals	Typical Uses
A	brass	copper and tin	musical instruments
B	bronze	copper and zinc	bells
C	duralumin	aluminium and copper	aircraft parts
D	solder	iron and tin	bridges

Which row of the table gives correct information about an alloy?

Your answer ☐ [1]

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73 The Haber process is used to manufacture ammonia, NH_3.

Ammonia is used to make fertilisers, which farmers use on their crops.

Explain why fertilisers are so important in the agricultural production of crops.

---

[2]

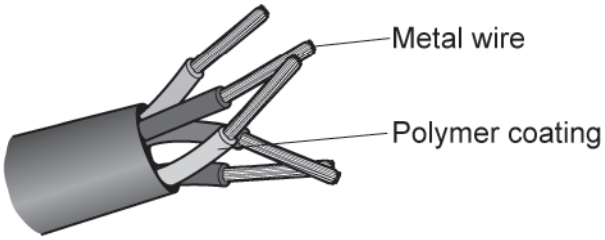
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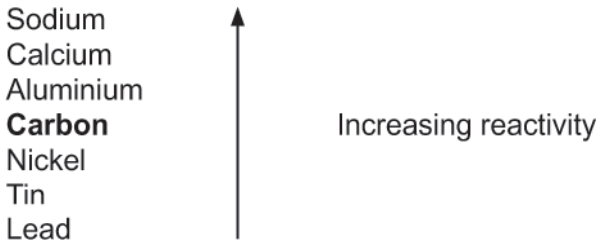
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(i) Describe how aluminium is recycled.

---

[2]

(ii) Describe and explain **two** advantages of recycling aluminium.
Use the information in the question in your answer.

---

[3]

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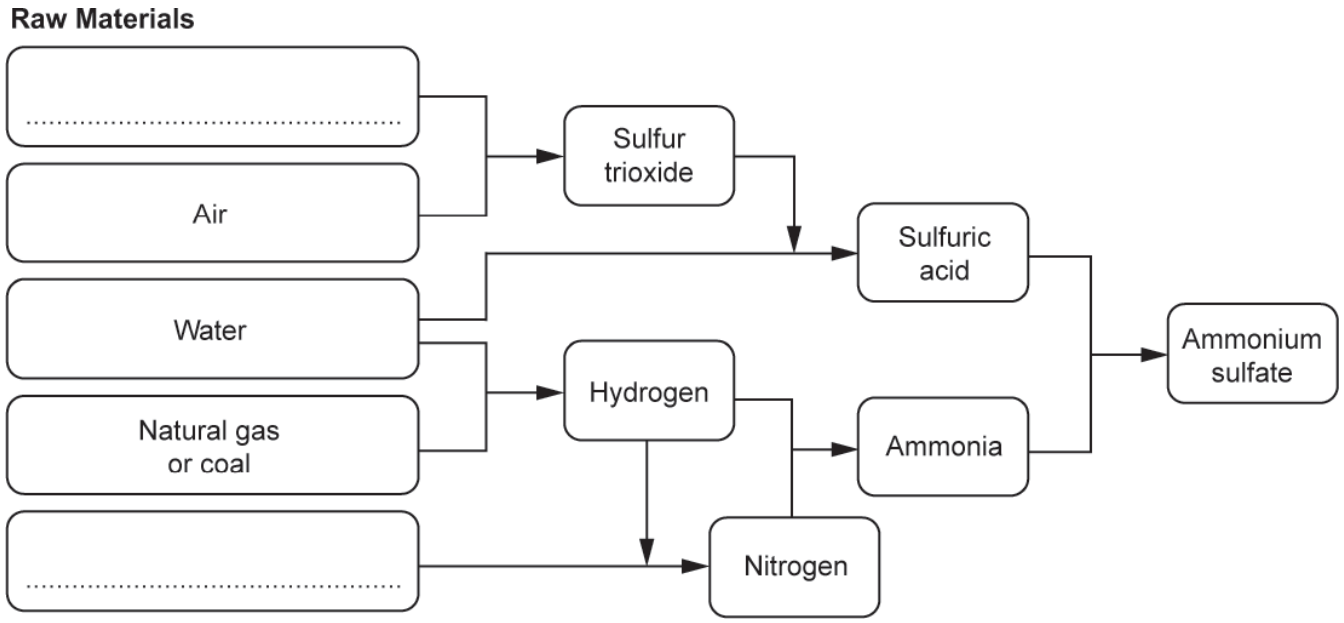
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[2]

(b) Ammonium sulfate is a fertiliser made from ammonia and sulfuric acid.

The diagram shows the stages in the industrial production of ammonium sulfate.

Complete the diagram to show the **raw materials** in the production of ammonium sulfate.



[2]

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76 Bioleaching is one method used to extract copper from ores.

Reactions involving bacteria slowly convert copper sulfide to a mixture of copper sulfate solution and sulfuric acid.

(i) Describe **two advantages** of extracting copper using bioleaching instead of traditional mining.

1 _____

_____

2 _____

_____

[2]

(ii) Suggest **one** reason why the sulfuric acid produced during bioleaching may be harmful to the environment.

_____

_____ **[1]**

END OF QUESTION PAPER