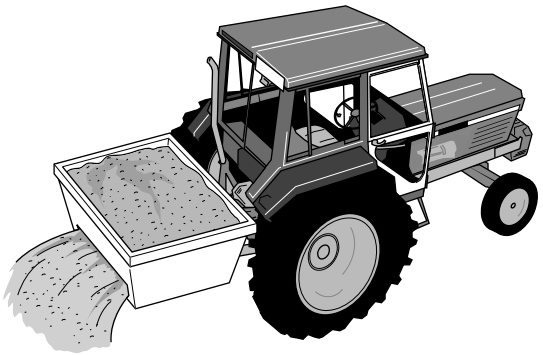
1 This question is about fertilisers.



Farmers use fertilisers to make crops grow bigger and faster. This increases crop yield.

(a) Explain how the use of fertilisers increases crop yield.

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..... **[2]**

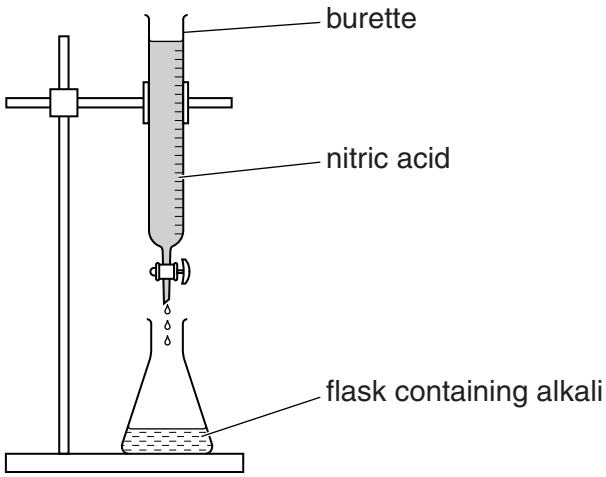
(b) Ammonium phosphate, $(NH_4)_3PO_4$, is used as a fertiliser.

Write down the total number of **atoms** in the formula $(NH_4)_3PO_4$.

answer ..... **[1]**

(c) Chloe makes some potassium nitrate by neutralising an alkali with nitric acid.

Look at the diagram. It shows the apparatus she uses.



(i) Write down the **name** of the **alkali** Chloe uses to make potassium nitrate.

..... **[1]**

(ii) Chloe adds nitric acid to the flask until the solution is **neutral**.

Explain, using the ions involved, why the alkali is neutralised by nitric acid.

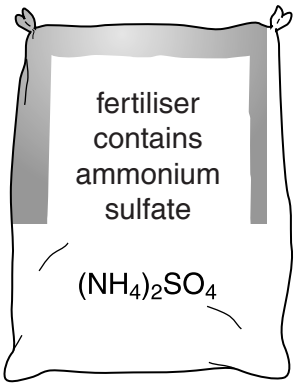
.....

..... **[1]**

[Total: 5]

2 Fertilisers and medicines are useful chemicals.

Ammonium sulfate is used as a fertiliser.



Ammonium sulfate is made by reacting ammonia with dilute sulfuric acid.

The ammonia needed for this reaction is made in a **continuous** process.

This is different to the **batch** process used to make most medicines.

(a) (i) A continuous process is used to make ammonia but a batch process is used to make most medicines.

Explain why.

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..... **[2]**

(ii) It is more expensive to make medicines than it is to make ammonium sulfate fertiliser.

Suggest why.

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..... **[1]**

(b) Alex makes some ammonium sulfate in a laboratory.

(i) Alex predicts he should make 8.0 g of ammonium sulfate.

He actually makes 6.0 g.

Show, by calculation, that his **percentage yield** of ammonium sulfate is 75%.

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..... **[2]**

(ii) The companies who make ammonium sulfate fertiliser on an industrial scale want as high a percentage yield as possible.

Explain why.

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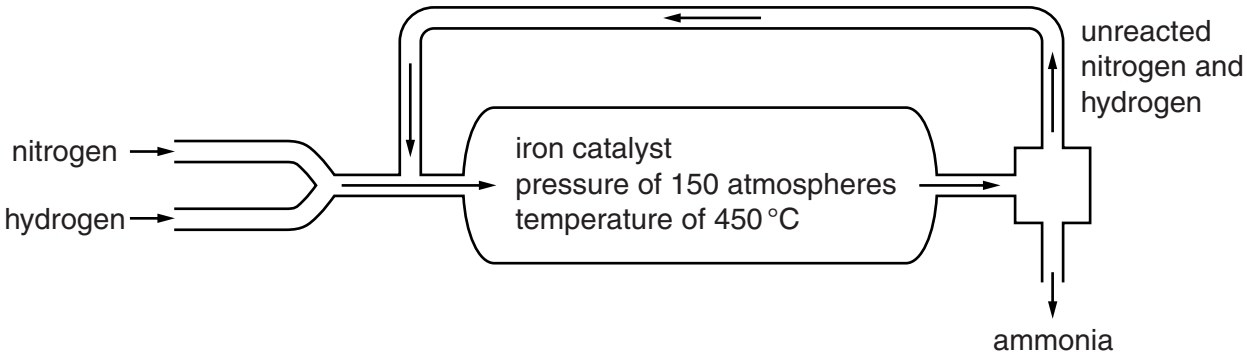
..... **[2]**

[Total: 7]

3 Look at the diagram. It shows how ammonia is made in the Haber process.



(a) Unreacted nitrogen and hydrogen are recycled.

Explain why.

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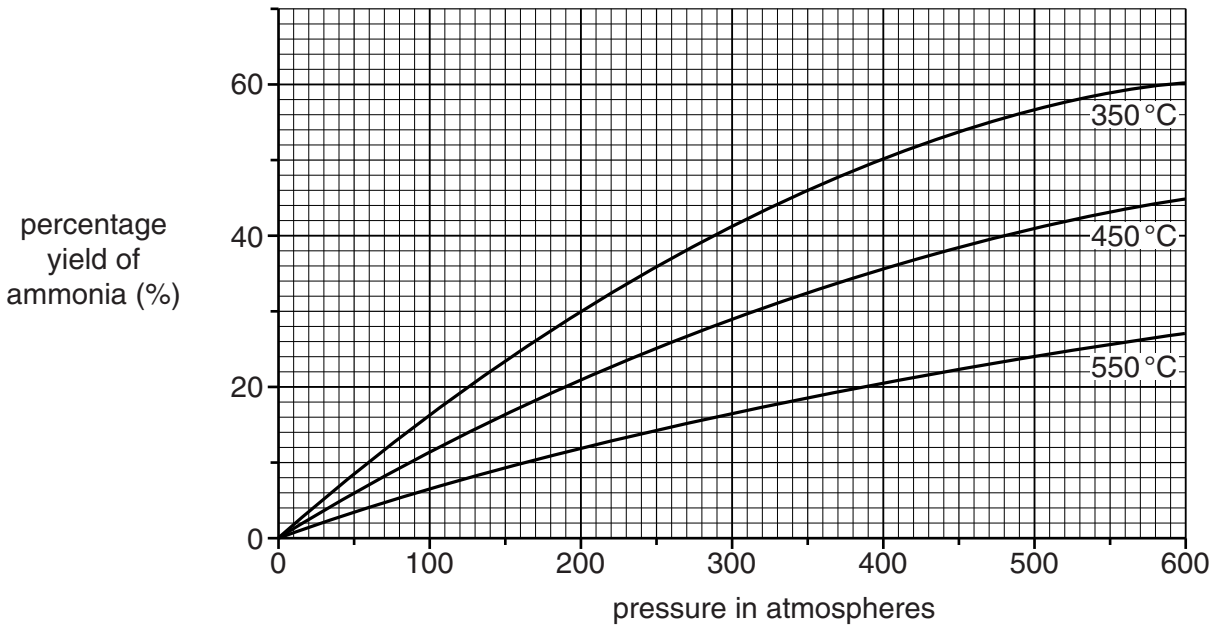
..... **[1]**

(b) Look at the graph.

It shows the percentage yield of ammonia at different temperatures and pressures.



What is the percentage yield of ammonia at **450 °C** and **400 atmospheres**?

answer ..... % **[1]**

(c) Look at the graph.

(i) What conditions, shown on the graph, give the **highest** yield of ammonia?

pressure = ... atmospheres

temperature = ... °C **[1]**

(ii) Ammonia is manufactured at 450 °C and 150 atmospheres using an iron catalyst.

Explain why these conditions are used.

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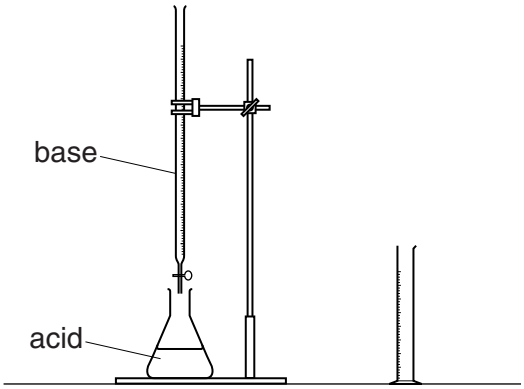
..... **[3]**

[Total: 6]

4 Jade and Philip are making fertilisers by neutralisation.



(a) Complete the **word** equation for neutralisation.

acid + base → ..... + water **[1]**

(b) Jade and Philip want to make potassium nitrate.

Which **acid** and which **base** should they use?

.....

..... **[2]**

(c) Jade and Philip also make ammonium phosphate.

The formula of ammonium phosphate is

$$(NH_4)_3PO_4$$

What is the total number of **atoms** in this formula?

..... **[1]**

[Total: 4]

5 Pharmaceutical drugs or medicines are speciality chemicals.

(a) Pharmaceutical drugs are often made by batch processes rather than continuous processes.

Explain why.

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..... **[1]**

(b) Pharmaceutical drugs often cost a lot of money to make and develop.

One reason is that it takes many years to research and test a new drug.

Explain **two** other reasons why it is expensive to make and develop a new drug.

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..... **[2]**

(c) Pharmaceutical drugs need to be tested to make sure they are safe to use.

The research and testing of pharmaceutical drugs may include

- animal testing
- testing on human volunteers.

The ideas and views of people in society affect the work of scientists.

Suggest how the ideas and views of people in society have changed the way scientists research and test pharmaceutical drugs.

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..... **[2]**

[Total: 5]

6 A power station burns methane, CH_4.

(a) Construct a **balanced symbol** equation for the complete combustion of methane.

..... **[2]**

(b) The power station produces nitrogen dioxide gas.

The owners need to stop the nitrogen dioxide going into the atmosphere.

They can choose two methods:

- use limestone
- use sea water.

Look at the table. It shows some information about each method.

	Limestone	**Sea water**
Percentage of nitrogen dioxide removed	90%	99%
Waste made	carbon dioxide and a solid waste product	none – sea water is pumped back into the sea
Cost	expensive	cheap
Availability	mined from under the ground	must be pumped in from the coast
Mass needed to remove 1 g of nitrogen dioxide	1.2 g	3000 g

The power station is 100 kilometres from the coast.

The power station makes 9000 g of nitrogen dioxide.

Which method would be more suitable for removing nitrogen dioxide from the waste gases?

Explain your answer.

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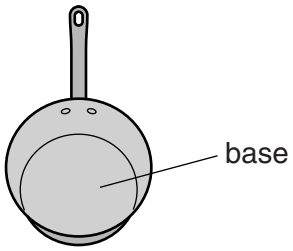
..... **[2]**

[Total: 4]

7 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

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

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Explain your answer.

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..... **[2]**

(b) Describe **metallic bonding** and explain why metals are good conductors of electricity.

You may wish to draw a labelled diagram.

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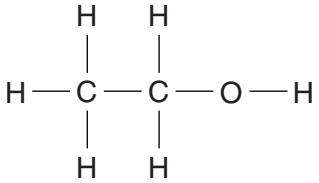
..... **[3]**

8 Ethanol, propanol and butanol are alcohols.

Look at the displayed formula of ethanol.



(a) Ethanol is made by the hydration of ethene, C_2H_4.

Write the **word** equation for this reaction.

..... **[1]**

(b) Alcohols have the general formula $C_nH_{2n+1}OH$.

(i) A molecule of propanol has **3** carbon atoms.

Write the formula of propanol.

..... **[1]**

(ii) Draw the **displayed** formula of butanol, C_4H_9OH.

[1]

(c) 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.

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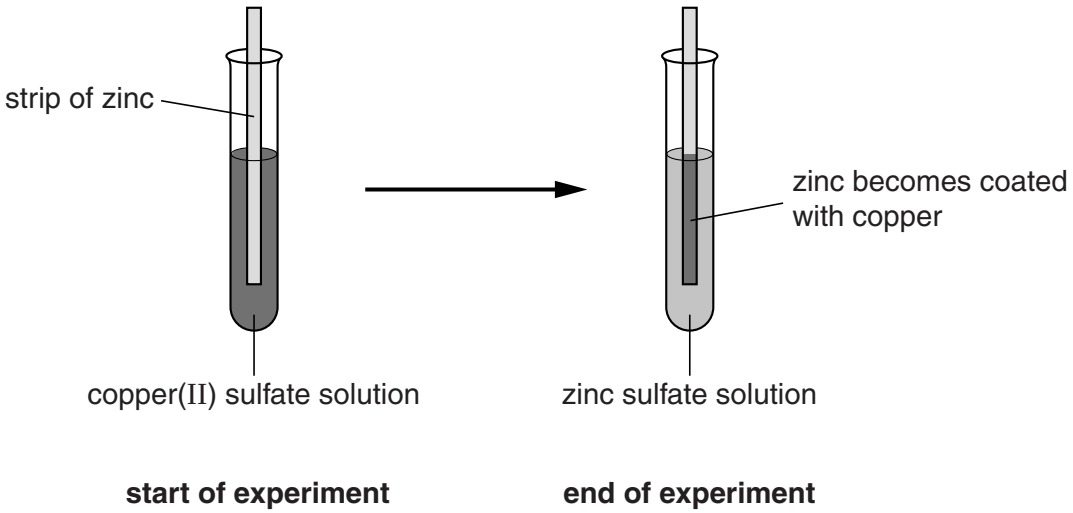
..... **[6]**

[Total: 9]

9 Jill investigates the reactivity of some metals.

Look at the diagram. It shows what happens when she puts a strip of zinc into copper(II) sulfate solution.



(a) Write the **word** equation for the reaction between zinc and copper(II) sulfate solution.

..... + ... → ..... + ...

....

[1]

(b) Iron rusts in the presence of oxygen and water.

Look at the equations for two reactions that happen during rusting.

$$Fe - 2e^- \rightarrow Fe^{2+}$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

Which reaction is oxidation and which is reduction?

Explain your answer.

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..... **[2]**

[Total: 3]

10 An acid reacts with a base to make a salt and water.

$$\text{acid} + \text{base} \longrightarrow \text{salt} + \text{water}$$

Look at the table. It shows some acids, bases and the salts made from them.

Acid	Base	Salt
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	.....
.....	zinc oxide	zinc chloride
sulfuric acid	.....	magnesium sulfate

(a) Complete the table. **[3]**

(b) Hydrochloric acid, HCl, reacts with calcium carbonate, $CaCO_3$.

Calcium chloride, $CaCl_2$, carbon dioxide and water are made.

Write a **balanced symbol** equation for this reaction.

..... **[2]**

(c) Acids contain hydrogen ions, H^+. Alkalis contain hydroxide ions, OH^-.

Write the **ionic** equation for neutralisation.

..... **[1]**

(d) Many fertilisers are made by neutralisation.

Fertilisers can cause **eutrophication**.

Explain what happens during eutrophication.

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..... **[3]**

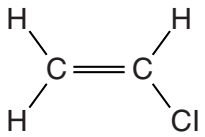
[Total: 9]

11 This question is about polymers.

(a) Poly(chloroethene) is a polymer.

Poly(chloroethene) is made from a monomer called chloroethene.

Look at the displayed formula of chloroethene.



Draw the displayed formula of poly(chloroethene).

[1]

(b) The plastic made from the polymer poly(chloroethene) can be used to make water pipes.

One property of poly(chloroethene) is that it is easy to shape.

Write about **other** properties of poly(chloroethene) that make it suitable for making water pipes.

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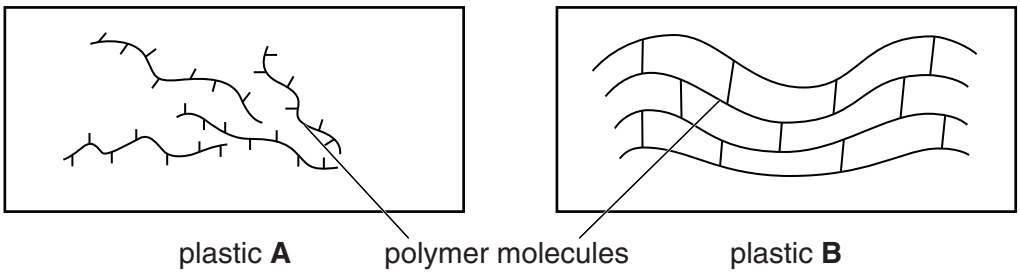
..... **[2]**

(c) Look at the diagrams. They show the structures of two plastics.



(i) Plastic **A** can be stretched easily.

Explain why.

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..... **[2]**

(ii) Plastic **B** has a high melting point.

Explain why.

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..... **[1]**

[Total: 6]