Improving Processes and Products (F)

1. 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]**

2. 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]**

3. 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]**

4. 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]**

5. 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]**

6 (a). 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.

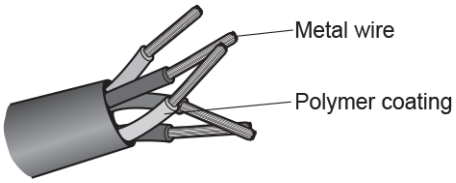
[3]

(b). 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]

(c). 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.

Sodium
Calcium
Aluminium
Carbon
Nickel
Tin
Lead

↑ Increasing reactivity

[1]

7 (a). The Haber process is used to manufacture ammonia, NH_3.

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

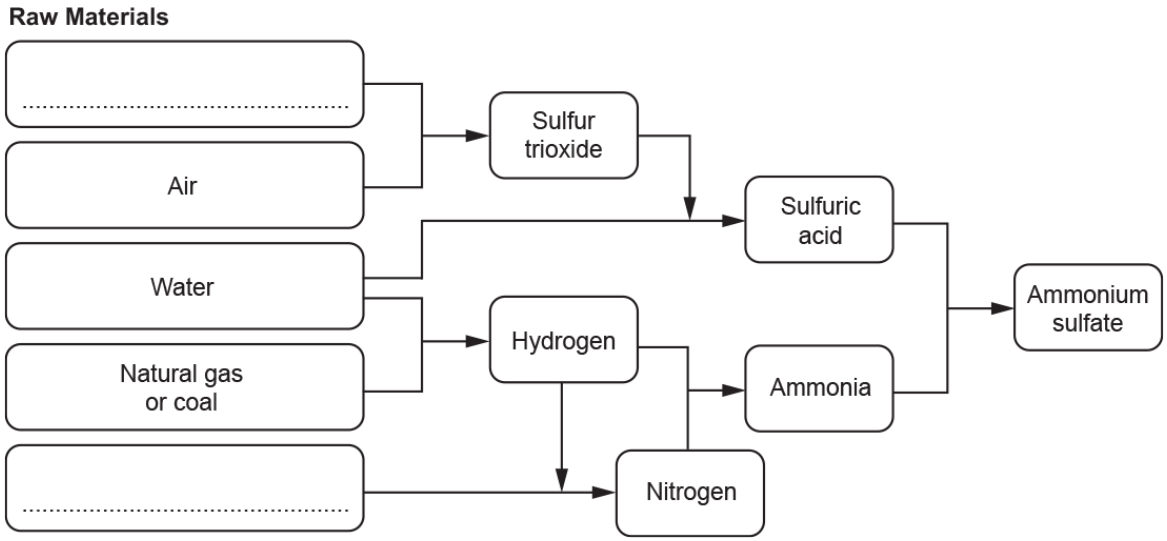
Explain why fertilisers are so important in the agricultural production of crops.

[2]

(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]

8. 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]

9. 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]**

10 (a). Ammonia is used to make fertilisers.

Fertilisers usually contain nitrogen.

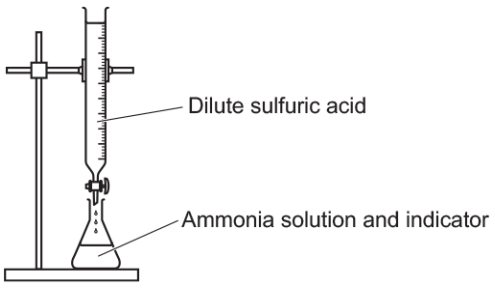
Name the **two** other elements that fertilisers usually contain.

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]

(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.

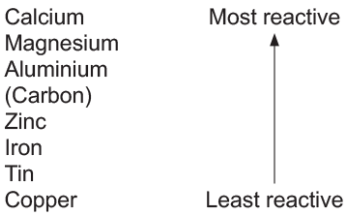
Describe and explain **two** ways that the student could improve his method to **increase** the amount of **pure**, **dry** calcium sulfate made.

1

2

[4]

11 (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]

(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]

12 (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.

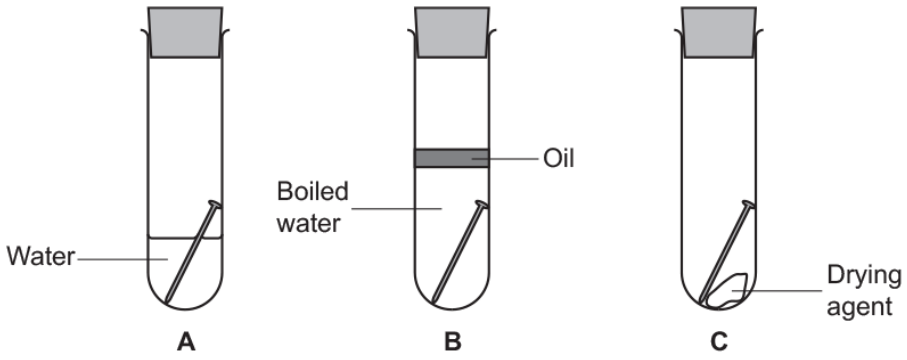


Fig. 16.1

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

Explain the observations.

Tube **A**

Tube **B**

Tube **C**

[3]

(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**.

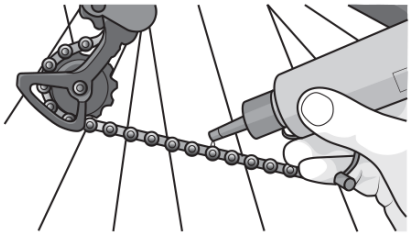


Fig. 16.2

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]

13(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?

[3]

14 (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]

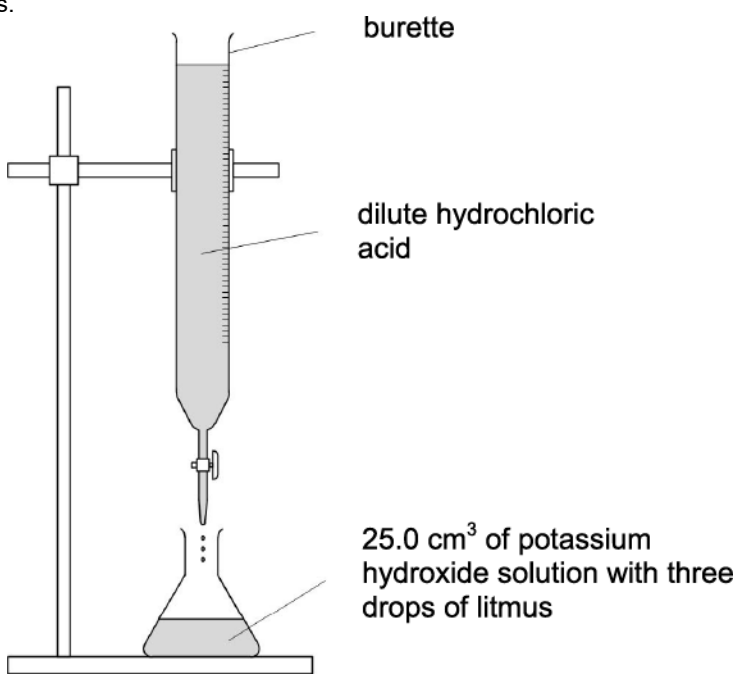
15. Polymers can be used to make clothes such as socks and jumpers.

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

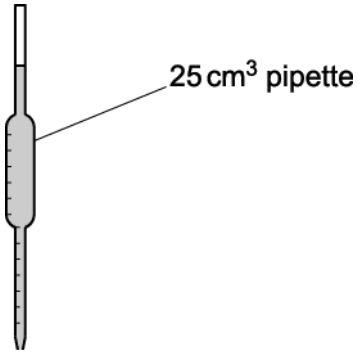
[1]

16 (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.



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.

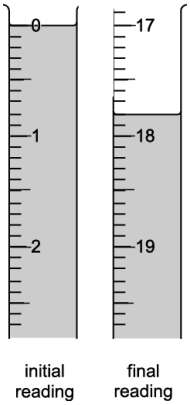
She then measures the volume of the hydrochloric acid again.

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.

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]**

END OF QUESTION PAPER