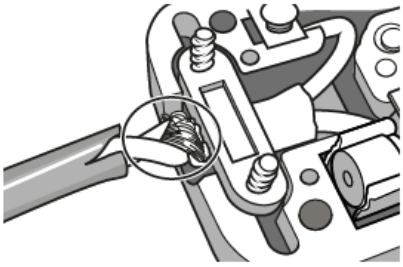
Improving processes and products – 2021/20 GCSE Gateway Chemistry A

1. Nov/2021/Paper_J248/02/No.2

The diagram shows the copper wires in a plug.



Why is this wire made of copper?

A Copper conducts electricity.

B Copper conducts heat.

C Copper is hard.

D Copper reacts only slowly with water.

Your answer ☐ **[1]**

2. Nov/2021/Paper_J248/02/No.18

Ammonia, NH_3, is made by the Haber process.

Look at the equation for the reaction.

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

(a) What is meant by the $\rightleftharpoons$ symbol in the equation?

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

(b) **Fig. 18.1** shows the percentage of ammonia made at different temperatures and pressures.

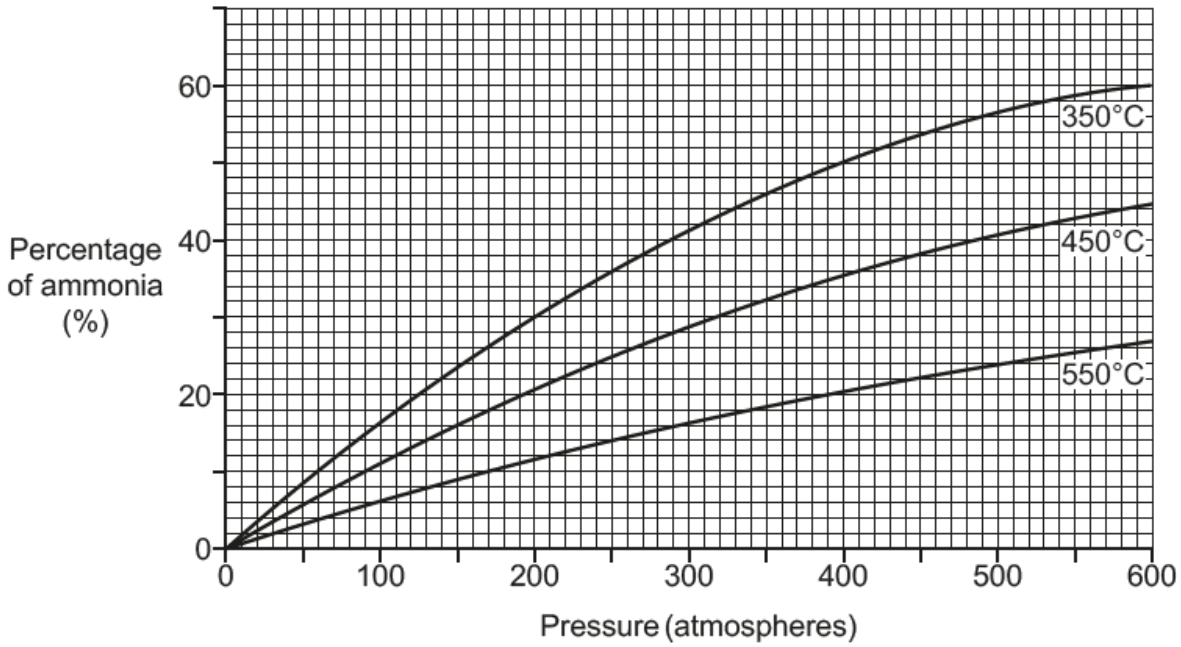


Fig. 18.1

(i) What is the percentage of ammonia made at **350 °C** and **200 atmospheres**?

Percentage of ammonia = ... % **[1]**

(ii) What temperature and pressure, shown on **Fig. 18.1**, make the **highest** percentage of ammonia?

Temperature = ... °C

Pressure = ... atmospheres **[1]**

(c) Ammonia reacts with nitric acid, HNO_3, to form the fertiliser ammonium nitrate, NH_4NO_3.

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

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

(d) Ammonium sulfate is another fertiliser that is made using ammonia.

State the **name** of the **acid** that reacts with ammonia to form ammonium sulfate.

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

(e) State **one** reason why farmers add fertilisers to soil.

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

(f) Some fertilisers must be dissolved in water before farmers can add them to the soil.

Fig. 18.2 shows information about the solubility of three fertilisers at different water temperatures.

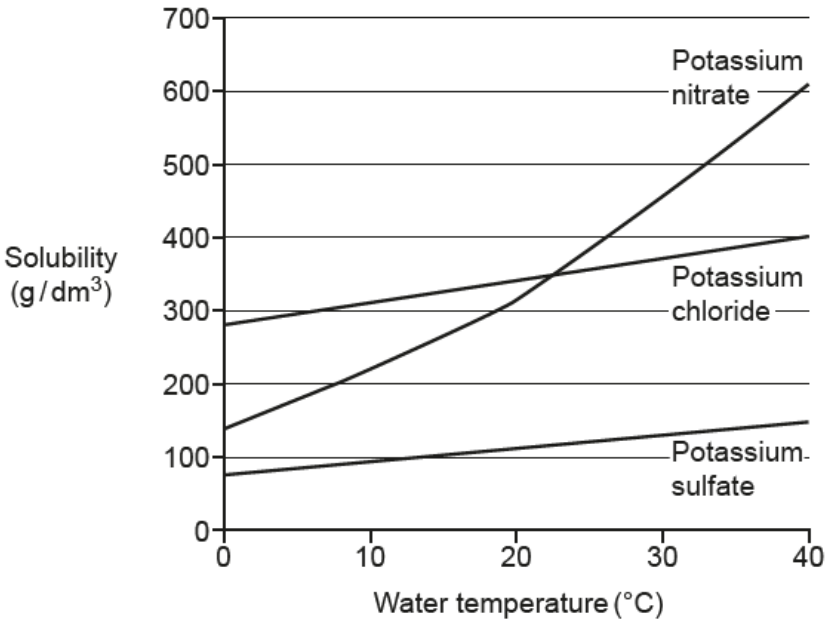


Fig. 18.2

Which fertiliser is **most** soluble in water at 20 °C?

Tick (✓) **one** box.

Potassium nitrate ☐

Potassium chloride ☐

Potassium sulfate ☐ **[1]**

(g) A student makes some ammonium sulfate in the laboratory.

This is the method she uses:

- Pour 25 cm^3 of dilute ammonia solution into a conical flask.
- Add 2–3 drops of methyl orange indicator.
- Add dilute acid from a burette until the reaction is complete.

(i) Explain how the student can make sure that the reaction is complete.

.....

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

(ii) Ammonia solution releases small amounts of ammonia gas.

Ammonia is a colourless gas with a sharp, irritating smell.

Describe how to control **one** hazard when making ammonium sulfate.

.....

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

(h) Potassium nitrate, KNO_3, is another fertiliser.

Potassium nitrate is made by reacting potassium hydroxide, KOH, with nitric acid, HNO_3.

$KOH + HNO_3 \rightarrow KNO_3 + H_2O$

Calculate the mass of potassium nitrate that can be made from 315 tonnes of nitric acid.

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

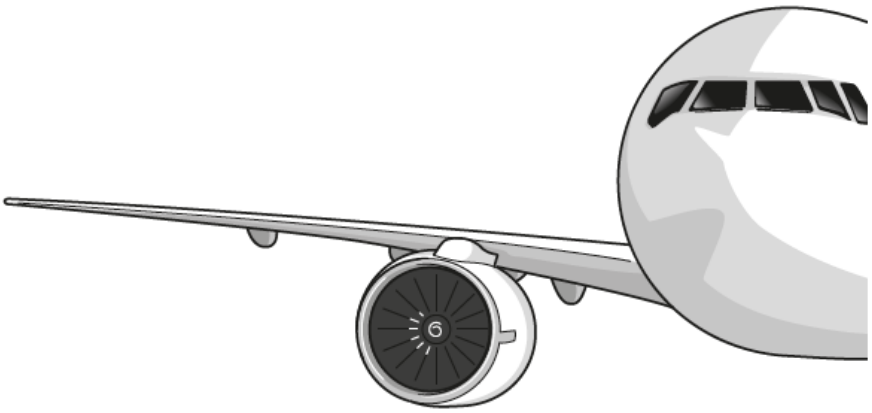
(The relative atomic mass, A_r, of H is 1.0, of K is 39.1, of N is 14.0 and of O is 16.0).

Mass of potassium nitrate = ... tonnes **[4]**

3. Nov/2021/Paper_J248/02/No.20

This question is about metals.

Look at the picture. It shows an aircraft wing.



The table shows the properties of three metals.

	Density (g/cm^3)	Relative electrical conductivity (0 = low, 10 = high)	Relative strength (0 = low, 10 = high)	Corrosion in moist air	Cost per tonne (£)
Aluminium	2.7	4	3	does not corrode	770
Copper	8.9	6	4	corrodes slowly	5900
Iron	7.9	1	6	corrodes	200

(a) Which metal in the table would you use to make the aircraft wing?

Explain your answer. Use information from the table to help you.

Metal .....

Explanation .....

.....

.....

..... **[4]**

(b) Aluminium can be made into an alloy called **duralumin**.

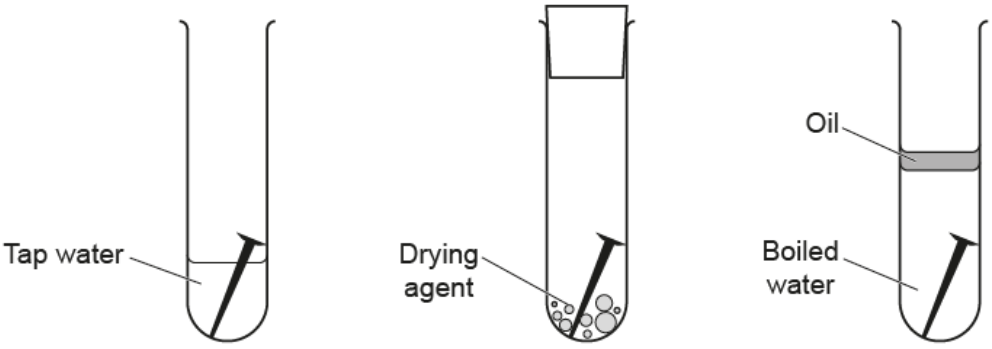
Which metal is mixed with aluminium to make duralumin?

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

(c) Iron corrodes. This is called rusting.

A student does an experiment to find out what conditions are needed to cause an iron nail to rust.

Look at the diagram of their experiment.



They leave the tubes for one week.

Predict in which tube the iron nail will rust.

Explain your answer.

Tube .....

Explanation .....

.....

.....

.....

..... **[4]**

(d) Describe and explain **one** way to prevent an iron bridge from rusting.

.....

.....

.....

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

4. Nov/2021/Paper_J248/02/No.22(a)

The table shows carbon can exist as several different structures called allotropes.

Allotrope	Covalent bonds
Diamond	.....
Graphite	.....
Graphene	3

(a) Complete the table to show how many covalent bonds carbon forms in these allotropes. **[2]**

5. Nov/2020/Paper_J248/02/No.1

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

6. Nov/2020/Paper_J248/02/No.4

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]**

7. Nov/2020/Paper_J248/02/No.5

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]**

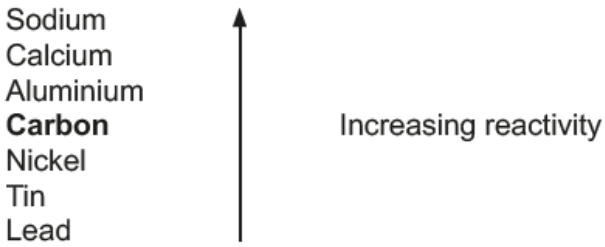
8. Nov/2020/Paper_J248/02/No.23(b, c)

(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.

.....

.....

.....

.....

.....

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

9. Nov/2020/Paper_J248/02/No.24

The Haber process is used to manufacture ammonia, NH_3.

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

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

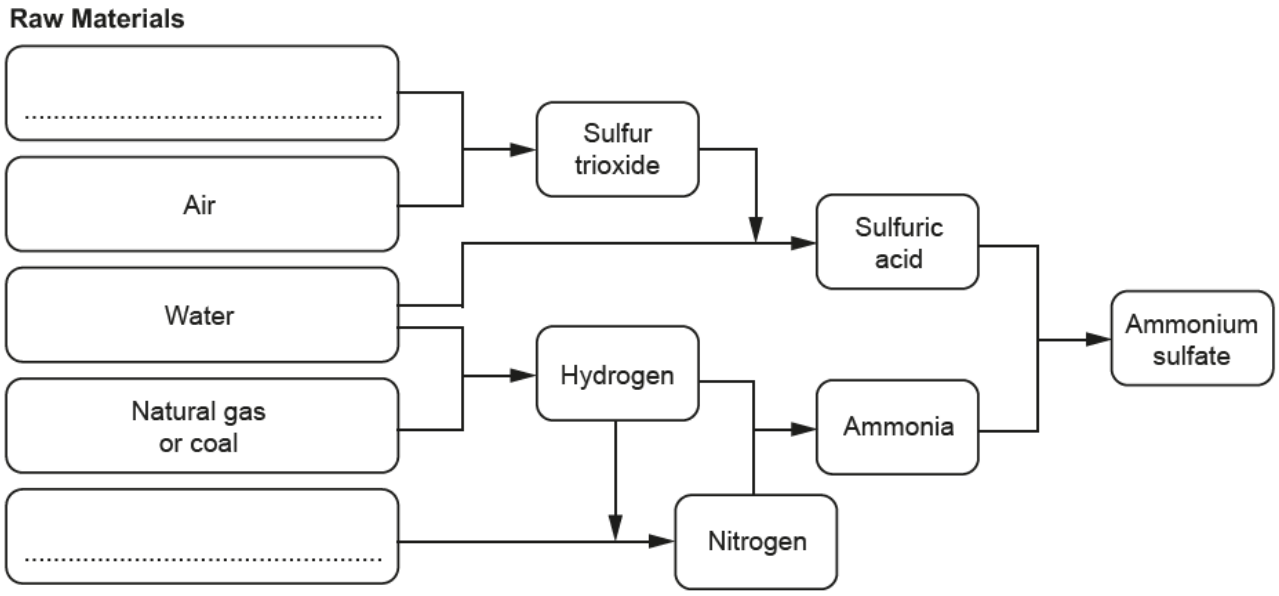
.....

..... **[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]**



(c) Ammonium nitrate, NH_4NO_3, is another fertiliser made from ammonia.

Ammonium nitrate is made by reacting ammonia with nitric acid.

$NH_3 + HNO_3 \rightarrow NH_4NO_3$

(i) Calculate the mass of **ammonium nitrate** that could be made from 25.5 tonnes of ammonia.

A_r: H = 1.0, N = 14.0, O = 16.0

Mass of ammonium nitrate = ... tonnes **[3]**

(ii) A student makes some ammonium nitrate in the laboratory.

He predicts that he should make 12.5 g of ammonium nitrate.

His percentage yield is 80%.

Calculate the **actual mass** of ammonium nitrate that the student makes.

Actual mass of ammonium nitrate = ... g **[2]**

10. Nov/2021/Paper_J248/04/No.4

What are the conditions usually used for the production of ammonia in the Haber process?

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

A 200 °C, 450 atmospheres pressure and an iron catalyst

B 450 °C, 2 atmospheres pressure and a vanadium(V) oxide catalyst

C 450 °C, 200 atmospheres pressure and an iron catalyst

D 450 °C, 200 atmospheres pressure and a nickel catalyst

Your answer ☐ **[1]**

11. Nov/2021/Paper_J248/04/No.6

When iron rusts it forms hydrated iron(III) oxide.

$4Fe + 3O_2 \rightarrow 2Fe_2O_3$

What happens to iron in this reaction?

A Iron is decomposed.

B Iron is neutralised.

C Iron is oxidised.

D Iron is reduced.

Your answer ☐ **[1]**

12. Nov/2021/Paper_J248/04/No.10

Metals can be extracted by biological methods.

Plants absorb metals through their roots and concentrate them in their cells.

What is this method of metal extraction called?

A Bioleaching

B Carbon capture

C Organic extraction

D Phytoextraction

Your answer ☐ **[1]**

13. Nov/2021/Paper_J248/04/No.14

Fertilisers can be made in a batch process in the laboratory or in a continuous process in industry.

The table gives some information about these two processes.

	Batch process	Continuous process
A	Easily automated	High production rate
B	Frequent shut-down periods	Large number of workers
C	Low production rate	High relative cost of equipment
D	Small number of workers	Low relative cost of equipment

Which row of the table is correct about the processes?

Your answer ☐ **[1]**

14. Nov/2021/Paper_J248/04/No.15

Sacrificial protection is a method used to prevent iron from rusting.

Sacrificial protection involves plating the iron with a more reactive metal such as zinc.

Which statement explains how sacrificial protection works?

A The more reactive metal gains electrons more easily than the iron.

B The more reactive metal is less readily oxidised than the iron.

C The more reactive metal is more readily reduced than the iron.

D The more reactive metal loses electrons more easily than the iron.

Your answer ☐ **[1]**

15. Nov/2021/Paper_J248/04/No.17(a)

A car manufacturer is designing a new car. They need to decide if the car will have a petrol engine or a diesel engine.

(a) The car manufacturer carries out a **life-cycle assessment** for both types of car.

(i) Describe the purpose of a life-cycle assessment.

.....

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

(ii) Describe **two** examples of data, other than waste products and pollution, that could be included in a life-cycle assessment.

1 .....

.....

2 .....

.....

[2]

16. Nov/2020/Paper_J248/04/No.5

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]**

17. Nov/2020/Paper_J248/04/No.16(b, c)

(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.

Sodium
Calcium
Aluminium
Carbon
Nickel
Tin
Lead

Increasing reactivity

.....

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

(c) Drinks cans are often made from aluminium.

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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]**

18. Nov/2020/Paper_J248/04/No.17(b, c)

The Haber process is used to manufacture ammonia, NH_3.

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

(a) 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]**