Separate Science (Chemistry) Unit 10 Using resources

Foundation

Question number	Description	Marks	Page number
4.10.1 Using the Earth's resources and obtaining potable water			
1	Box matching steps and reason for producing drinking water, substances to sterilise fresh water multiple choice, methods to test for dissolved solids multiple choice, (4.8.3 matching ions to compound needed to identify the ion), method to produced pure water multiple choice	9	5
3	Apparatus multiple choice, calculating mean from results table to two significant figures, distillation of seawater diagram and questions, reasons why river water is filtered and sterilised	9	8
5	Reading percentage from graph, completing bar graph, **conservation of mass (kg) of word equation**, (4.5.1 reaction profiles – label activation energy and draw profile with a catalyst)	8	12
8	Defining potable water, describing role of sand in filtration, calculation using information on methods of purifying water in table and the question, using information in table to give disadvantages and advantages of methods of purifying water, method of sterilising water	8	16
4.10.2 Life cycle assessment and recycling			
6	Define life cycle assessments, compare methods for disposal of plastic bags using life cycle assessment table	5	19
4.10.3 Using resources			
4	Plot data from table on bar graph, calculate cost of gold in 9 carat ring using information from table and question, calculate mass of gold in 22 carat ring mass 5g and using information in table, suggest reasons why silver and copper re mixed with gold to make rings, three reasons copper should be recycled rather than mined	10	20

6	Plan investigation to show water and air are needed for iron to rust (6 marks), calculate increase in mass from experiment results, calculate mean from results table	8	23
4.10.4 The Haber process and the use of NPK fertilisers			
3	Meaning of reversible reaction symbol, name energy change in reverse reaction, catalyst multiple choice, describe how ammonia production changed on a graph, reasons for increase in ammonia production multiple choice, multiple choice using table on percentage by mass of NPK in fertiliser	10	25
4	(Several units – Percentage of Earth's atmosphere multiple choice, reversible reaction symbol, equilibrium gap fill, define formulation), plotting results from results on bar graph, multiple choice for percentage calculation described, using information from graph to decide if a student statement is correct	10	29

Common content

Question number	Description	Marks	Page number
4.10.2 Life cycle assessment and recycling			
2	Evaluating use of different carrier bags from life cycle assessment information in a table and own knowledge	6	33
3	Calculate percentage of mass of used cans that are recycled and answer in standard form, evaluate use of aluminium compared with PET for drinks containers using information form life cycle assessment table and calculations (6 marks)	10	35
4.10.4 The Haber process and the use of NPK fertilisers			
3	Name gas used to produce ammonia, give temperature and pressure for Haber process, reason why ammonia condenses but hydrogen and nitrogen do not, (4.10.1 explain processes that have changed the Earth's early atmosphere to today's atmosphere (6 marks)), reason why scientists not sure of Earth's early atmosphere	11	38

Higher

Question number	Description	Marks	Page number
4.10.1 Using the Earth's resources and obtaining potable water			
3	Calculate mass of dissolved solids in water from results of experiment, advantage and disadvantage of using large volume for water for experiment, describe difference between potable and pure water, describe how ground and sea water are treated to produce potable water, calculate mass of dissolved solid using information in the question and results table	9	41
4	Naming processes happening in sewage treatment diagram, explain why air is bubbled through effluent, why water is sterilised, name method of desalination, describe method to measure concentration of dissolved solids in sample of seawater (6 marks)	14	44
4.10.2 Life cycle assessment and recycling			
10	Evaluate use of different paper cup coating using life cycle assessment table and own knowledge (6 marks), calculation based on data from LCA table and answer in standard form, (4.10.3 explain why polymer does not melt when heated)	10	47
4.10.3 Using resources			
4	Describe how coper is produced by phytomining, **calculate number of moles of copper produced from 1 dm^3 of solution with concentration given in question**, (4.5.1 reaction profile multiple choice), (4.10.1 reason why producing ethanol from carbon dioxide is sustainable, define sustainable development)	12	49
4	Explain results of placing iron nail in different test tubes in diagrams, explain how magnesium fixed to steel prevents rusting, explain why aluminium window frames do not corrode	9	52
6	Name and organisms used for two biological methods of producing copper, three reasons why biological methods are used to extract copper, explain why copper is extracted from copper sulphate by adding iron, complete symbol and state symbol equation for copper sulphate and iron reaction, **calculate number of copper ions in a given mass**	15	54

4.10.4 The Haber process and the use of NPK fertilisers			
10	Calculate atom economy for a reaction to produce hydrogen, explain why low pressure is used for reversible reaction to produce hydrogen, give effect on yield of hydrogen of increasing pressure in a different reaction, use graph to determine how many time greater percentage yield of ammonia is a different conditions, give a reason why named conditions are not used for Haber process, reason why graph shows forward reaction in Haber process is exothermic, reason why world production of ammonia has increased	12	56

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 This question is about drinking water.

There are two main steps in producing drinking water from fresh water.

0 1 . 1 Draw **one** line from each step to the reason for the step.

[2 marks]

Step	Reason for step
	Desalination
Filtration	Improve taste
	Increase pH
Sterilisation	Kill bacteria
	Remove solids

0 1 . 2 Which **two** substances are used to sterilise fresh water?

[2 marks]

Tick (✓) **two** boxes.

- Ammonia ☐
- Chlorine ☐
- Hydrogen ☐
- Nitrogen ☐
- Ozone ☐

Turn over ▶

Do not write outside the box

A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.

0 1 . 3 Scientists tested a sample of the drinking water to show that it contained dissolved solids.

Which **two** methods show the presence of dissolved solids in the sample of drinking water?

[2 marks]

Tick (✓) **two** boxes.

Add damp litmus paper to the sample. ☐

Evaporate all water from the sample. ☐

Measure the sample's boiling point. ☐

Test the sample with a glowing splint. ☐

Do not write outside the box

0 1 . 4 Scientists tested two water samples from the drinking water supply.

The scientists tested one sample for aluminium ions and the other sample for sulfate ions.

Draw **one** line from each ion to the compound needed to identify the ion.

[2 marks]

Ion	**Compound needed to identify ion**
	Barium chloride
Aluminium ion	Copper sulfate
	Silver nitrate
Sulfate ion	Sodium hydroxide
	Sulfuric acid

0 1 . 5 How could pure water be produced from drinking water that contained dissolved solids?

[1 mark]

Tick (✓) **one** box.

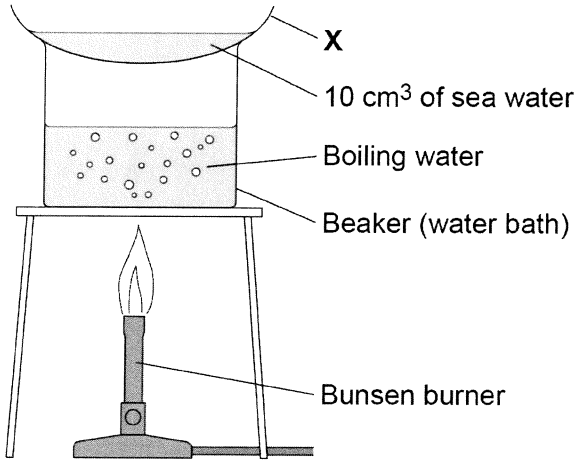
- Chromatography ☐
- Cracking ☐
- Distillation ☐
- Sedimentation ☐

9

0 3 A student tested a sea water sample for dissolved solids.

Figure 6 shows the apparatus.

Figure 6



0 3 . 1 What is apparatus **X** on **Figure 6**?

[1 mark]

Tick **one** box.

Boiling tube ☐

Condenser ☐

Funnel ☐

Watch glass ☐

Do not write outside the box

0 3 . 2 The student did the test four times.

The student calculated the mass of solid on apparatus **X** after heating.

Table 3 shows the student's results.

Table 3

	Test 1	**Test 2**	**Test 3**	**Test 4**
Mass of solid in grams	0.12	0.29	0.14	0.15

Calculate the mean mass of solid.

Do not include the anomalous result in your calculation.

Give your answer to 2 significant figures.

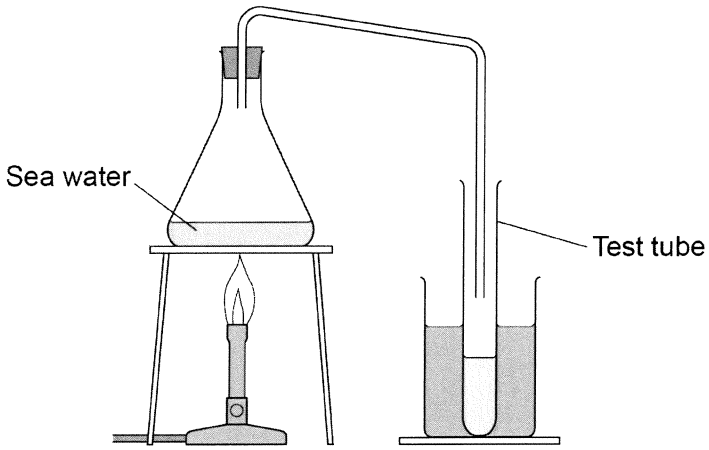
[3 marks]

Mean mass = _____ g

Question 3 continues on the next page

The student distilled a sample of sea water in the apparatus shown in **Figure 7**

Figure 7



0 3 . 3 What change of state is happening at the surface of the sea water in **Figure 7**?

[1 mark]

0 3 . 4 Describe how the water in the test tube in **Figure 7** is different from the sea water.

[1 mark]

0 3 . 5 Why does producing drinking water from sea water using distillation cost a lot of money?

[1 mark]

Do not write outside the box

0 3 . 6 River water is filtered then sterilised to make drinking water.

Why are these **two** processes done?

[2 marks]

Filtering _____

_____

Sterilising _____

_____

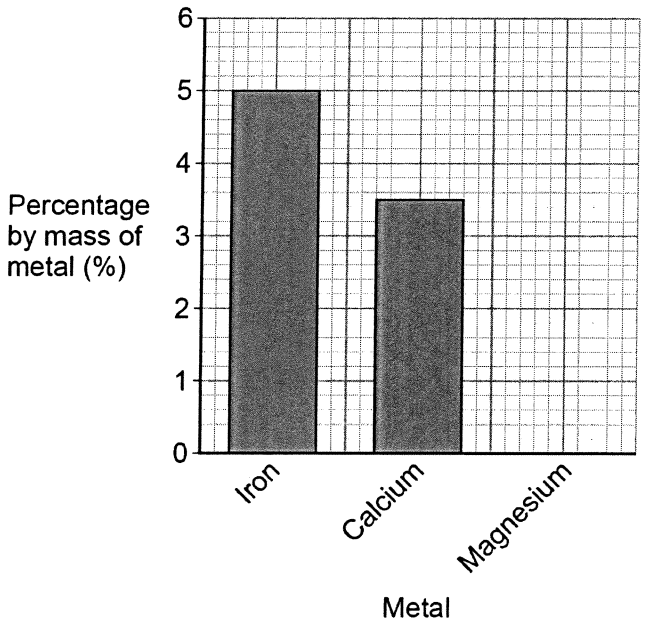
9

Turn over for the next question

Do not write outside the box

0 5 **Figure 6** shows the percentage by mass of some metals in the Earth's crust.

Figure 6



0 5 . 1 What is the percentage by mass of calcium in the Earth's crust?

[1 mark]

Tick (✓) **one** box.

3.25% ☐ 3.50% ☐ 4.50% ☐ 5.00% ☐

0 5 . 2 The percentage by mass of magnesium in the Earth's crust is 2.1%

Draw the bar for magnesium on **Figure 6**.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 Copper sulfate is produced during the extraction of copper from the Earth's crust.

Copper is produced from copper sulfate solution using iron.

The word equation for the reaction is:

copper sulfate + iron → iron sulfate + copper

From the equation a company calculated that 648 kg of copper sulfate are needed to produce 617 kg of iron sulfate and 258 kg of copper.

Calculate the mass of iron needed to make 258 kg of copper.

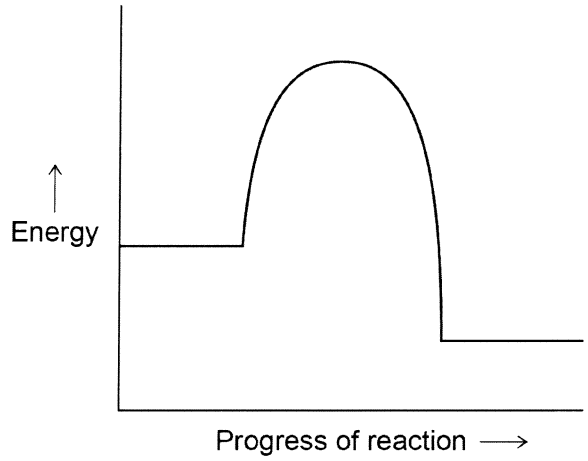
[2 marks]

Mass = _____ kg

Copper is used as a catalyst.

0 5 . 4 **Figure 7** shows the reaction profile for a reaction without a catalyst.

Figure 7

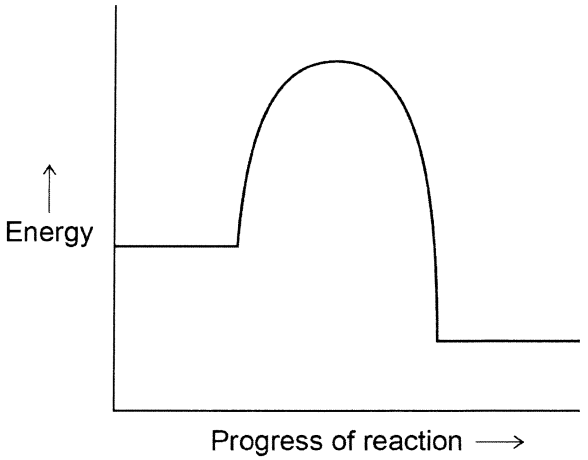


Draw an arrow on **Figure 7** to show the activation energy.

[1 mark]

0 5 . 5 The reaction profile for the reaction without a catalyst is shown again in **Figure 8.**

Figure 8



Draw a reaction profile on **Figure 8** for the same reaction with a catalyst.

[2 marks]

Do not write outside the box

0 5 . 6 What are catalysts in biological systems called?

[1 mark]

Tick (✓) **one** box.

- Detergents ☐
- Enzymes ☐
- Polymers ☐
- Solvents ☐

8

Do not write outside the box

0 8 Water is important to all living organisms.

In some parts of Africa getting potable water may be difficult.

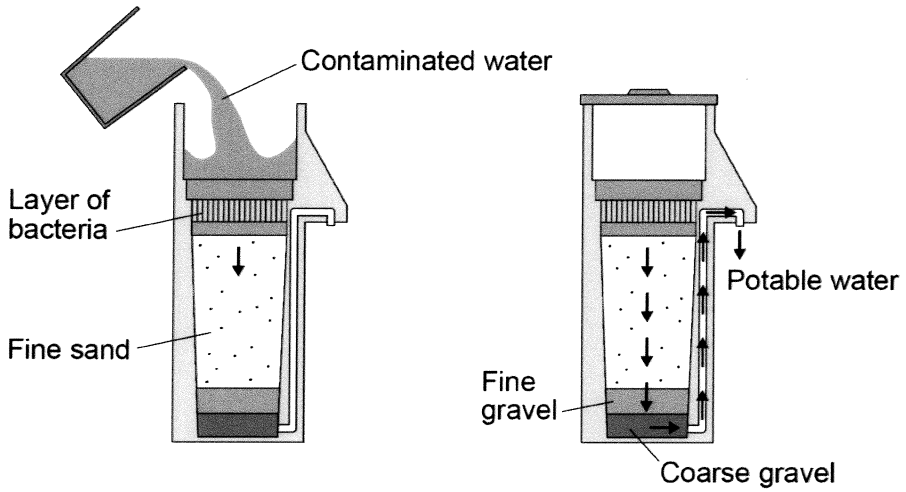
0 8 . 1 What is potable water?

[1 mark]

Biosand units are one method of purifying water used in some parts of Africa.

Figure 11 shows a Biosand unit.

Figure 11



0 8 . 2 Describe the role of the fine sand.

[1 mark]

Question 8 continues on the next page

Another method of purifying water is Solar Disinfection (SODIS).

Table 4 gives some information about both methods.

Table 4

Method	Description	Percentage reduction in pathogens that cause diarrhoea
Biosand unit	Before use, it needs to be left for 2 weeks for the bacteria in the unit to grow. Can treat 40 litres of water per hour. Made of concrete. Needs replacing every 10 years.	47
SODIS	Plastic bottles are filled with water and left in sunlight. Ultraviolet (UV) kills bacteria. Bottles need to be left in sunlight for at least 8 hours. Bottles have to be replaced every 6 months.	31

0 8 . 3 A 1 litre bottle for SODIS costs 29p. Each litre bottle needs replacing after 6 months.

A family uses 6 litres of potable water per day.

Calculate the cost per year of using SODIS for the family.

[2 marks]

Cost per year = £ _____

Do not write outside the box

0 8 . 4 Other than cost, give **two** disadvantages of using the Biosand unit instead of SODIS.

[2 marks]

1 _____

_____

2 _____

_____

0 8 . 5 Give **two** advantages of using the Biosand unit instead of SODIS.

[2 marks]

1 _____

_____

2 _____

_____

0 8 . 6 SODIS uses UV light to sterilise water.

Give **one** other method of sterilising water.

[1 mark]

_____

_____

9

Turn over for the next question

Do not write outside the box

Table 6 shows data from a life cycle assessment (LCA) for the disposal of 10 000 biodegradable plastic bags.

Table 6

	Burning and using the energy to generate electricity	Landfill
Mass of carbon dioxide produced in kg	25	15
Mass of solid residue in kg	0.050	0.070
Mass of sulfur dioxide produced in kg	0.20	0.30

0 6 . 7 Why are life cycle assessments (LCA) done?

[1 mark]

0 6 . 8 Compare the **two** methods for the disposal of biodegradable plastic bags.

Use information from **Table 6**

[4 marks]

5

0 4 A 9 carat gold ring is made from a mixture of metals.

Table 3 shows the mass of different metals in the ring.

The mass of the ring is 5.0 g

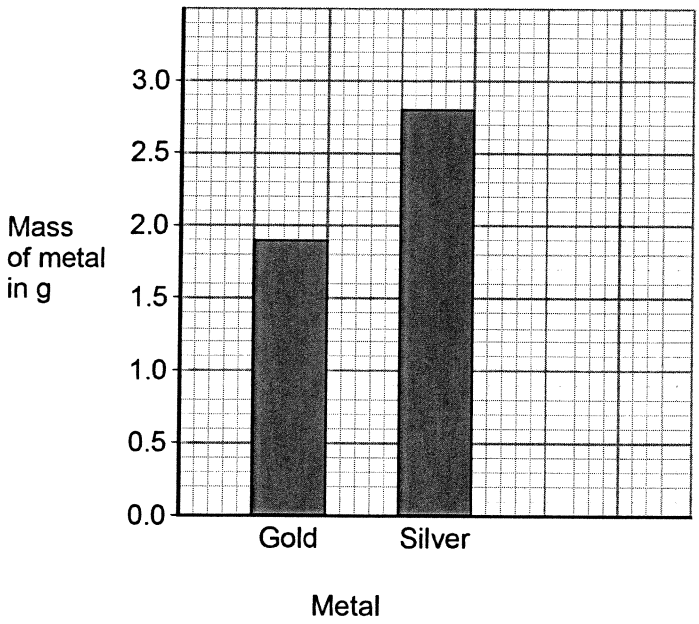
Table 3

Metal	Mass of metal in g
Gold	1.9
Silver	2.8
Copper	0.3

0 4 . 1 Plot the data for copper from **Table 3** on **Figure 1**.

[2 marks]

Figure 1



Do not write outside the box

0 4 . 2 The cost of gold is £30 per gram.

Calculate the cost of the gold used in the 9 carat gold ring.

Use **Table 3**.

[1 mark]

Cost of gold = £ _____

0 4 . 3 Rings can be made from 22 carat gold.

The ratio of the mass of gold in 22 carat gold compared to 9 carat gold is 22 : 9

Calculate the mass of gold in a 22 carat gold ring of mass 5.0 g

Use **Table 3**.

[2 marks]

Mass of gold = _____ g

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 Pure gold is 24 carat.

Suggest **two** reasons why silver and copper are mixed with gold to make 9 carat gold rings.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 5 Copper is obtained from copper ores or by recycling copper.

- Copper ores are non-renewable.
- Copper ores can be obtained by mining.
- Some scrap copper goes to landfill sites.

Give **three** reasons why we should use recycled copper instead of copper from copper ores.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

10

Do not write outside the box

0 6 This question is about the corrosion of metals.

The corrosion of iron is called rusting.

0 6 . 1 Plan an investigation to show that both water and air are needed for iron to rust.

You should include the results you expect to obtain.

Use apparatus and materials from the list:

- test tubes
- stoppers
- iron nails
- tap water
- boiled water
- drying agent
- oil.

[6 marks]

Do not write outside the box

A student investigated how the mass of three iron nails, **A**, **B** and **C**, increased after rusting.

Table 4 shows the student's results.

Table 4

Nail	Mass of nail before rusting in g	Mass of nail after rusting in g	Increase in mass of nail in g
A	1.22	1.30	0.08
B	1.25	1.36	**X**
C	1.24	1.33	0.09

0 6 . 2 Calculate **X** in **Table 4**.

[1 mark]

X = _____ g

0 6 . 3 Calculate the mean increase in mass of the three iron nails, **A**, **B** and **C**.

Use **Table 4** and your answer to Question **06.2**

[1 mark]

Mean increase in mass = _____ g

8

Turn over ▶

Do not write outside the box

0 3 Hydrogen is a raw material in the Haber process.

Hydrogen is produced from methane.

The word equation for the reaction is:

methane + steam ⇌ carbon monoxide + hydrogen

0 3 . 1 How can you tell that the reaction is reversible?

[1 mark]

0 3 . 2 The forward reaction is endothermic.

Name the type of energy change in the reverse reaction.

[1 mark]

0 3 . 3 A nickel catalyst is used in this reaction.

Why is a catalyst used in this reaction?

[2 marks]

Tick (✓) **two** boxes.

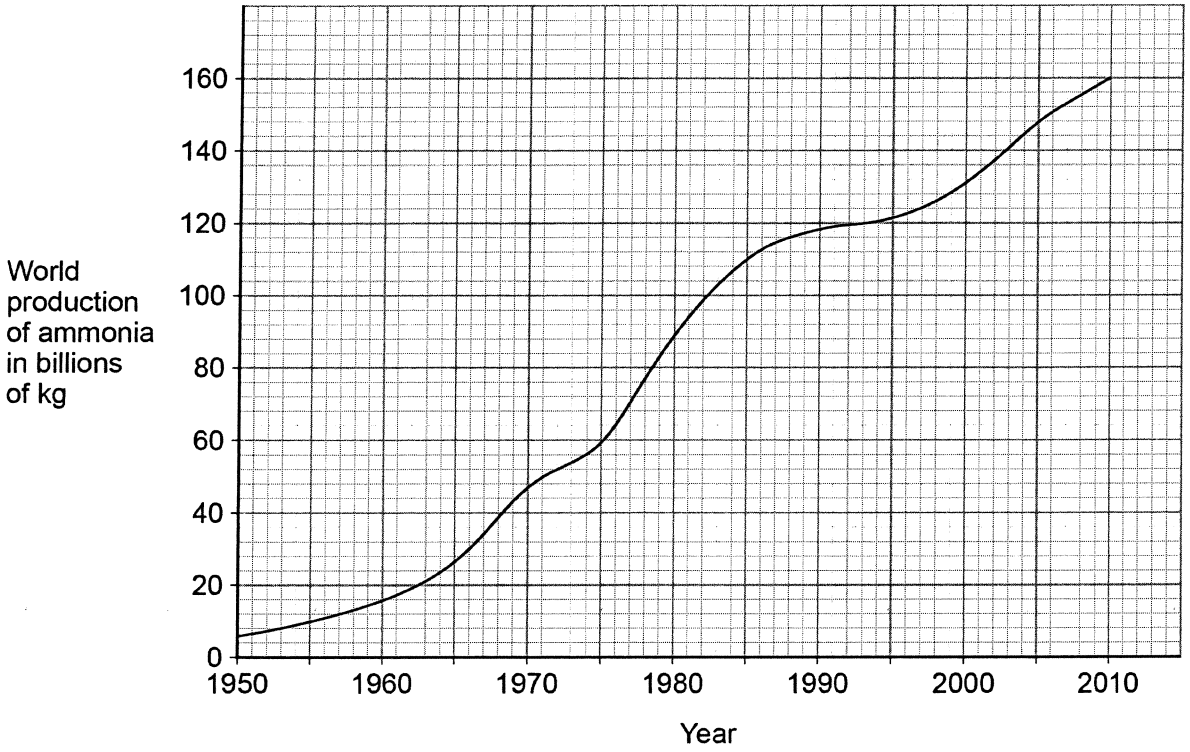
- To increase the temperature ☐
- To produce less carbon monoxide ☐
- To reduce costs ☐
- To use less energy ☐
- To use less methane ☐

Do not write outside the box

0 3 . 4 The Haber process also uses nitrogen to produce ammonia.

Figure 1 shows how the world production of ammonia changed between 1950 and 2010.

Figure 1



Describe how the world production of ammonia changed between 1950 and 2010.

[2 marks]

Do not write outside the box

Most of the ammonia produced is used to make fertilisers.

0 3 . 5 Why did the world production of ammonia change between 1950 and 2010?

[2 marks]

Tick (✓) **two** boxes.

The demand for food changed. ☐

The demand for fuels changed. ☐

The nitrogen percentage in air changed. ☐

The number of cars changed. ☐

The world population changed. ☐

Table 1 shows data about four fertilisers, **A**, **B**, **C** and **D**.

Table 1

Fertiliser	Percentage by mass of nitrogen (%)	Percentage by mass of phosphorus (%)	Percentage by mass of potassium (%)
A	35.0	0.0	0.0
B	21.2	0.0	0.0
C	21.2	23.5	0.0
D	0.0	0.0	52.3

Do not write outside the box

0 3 . 6 Which combination of fertilisers **A**, **B**, **C** and **D** provides **all** of the elements needed for an NPK fertiliser?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A and **C** ☐

A and **D** ☐

B and **C** ☐

C and **D** ☐

0 3 . 7 Which fertiliser is **not** made using ammonia?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

10

Do not write outside the box

0 4 . 1 What percentage of the Earth's atmosphere is nitrogen?

[1 mark]

Tick **one** box.

5% ☐ 20% ☐ 50% ☐ 80% ☐

0 4 . 2 During the first billion years of the Earth's existence the amount of nitrogen in the atmosphere increased.

Give **one** source of this nitrogen.

[1 mark]

_____

0 4 . 3 Nitrogen is used to make ammonia.

The word equation for the reaction is:

nitrogen + hydrogen _____ ammonia

Write the correct symbol in the equation to show that it is a reversible reaction.

[1 mark]

0 4 . 4 A reversible reaction can reach equilibrium.

Complete the sentence.

[1 mark]

Equilibrium is reached when the forward reaction and the reverse reaction happen at the same _____ .

0 4 . 5 Fertilisers are formulations containing nitrogen.

What is a formulation?

[1 mark]

_____

_____

Do not write outside the box

0 4 . 6 **Table 4** shows percentages of chemical elements in a fertiliser.

Table 4

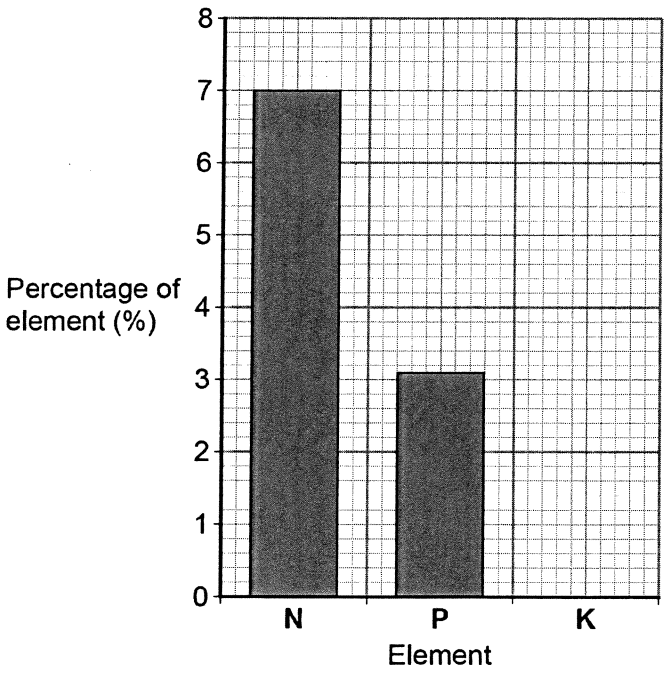
Element	Percentage (%)
Nitrogen (N)	7.0
Phosphorus (P)	3.1
Potassium (K)	5.8

Draw the bar for potassium on **Figure 8**

Use the information in **Table 4**

[1 mark]

Figure 8



Do not write outside the box

0 4 . 7 A fertiliser contains 0.225 g of iron per 3.0 g of fertiliser.

Which calculation gives the percentage of iron in the fertiliser?

[1 mark]

Tick **one** box.

$\frac{0.225}{3.0 \times 100}$ ☐

$\frac{3.0 \times 100}{0.225}$ ☐

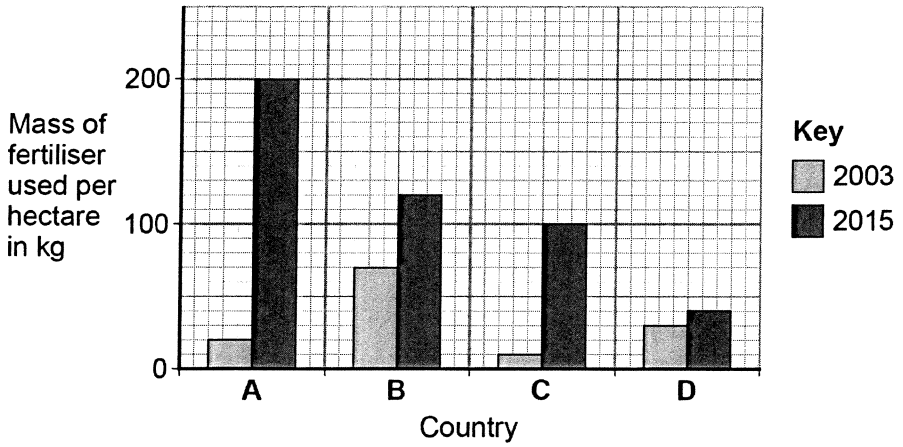
$\frac{0.225 \times 3.0}{100}$ ☐

$\frac{0.225 \times 100}{3.0}$ ☐

Do not write outside the box

0 4 . 8 **Figure 9** shows the use of fertiliser in four different countries, **A**, **B**, **C** and **D**, in 2003 and 2015

Figure 9



A student said:

'**much** more fertiliser was used in 2015 than in 2003'

Is the student correct?

Use data from **Figure 9** to justify your answer.

[3 marks]

10

Turn over for the next question

Do not write outside the box

0 2 . 6 There are two types of carrier bag in common use:

- disposable bags
- bags for life.

Bags for life can be returned to the supermarket when no longer usable.

The supermarket replaces the bag for life free of charge and arranges for the bag to be recycled.

Table 1 shows data from a life cycle assessment (LCA) for the two types of carrier bag.

Table 1

	Disposable bag	**Bag for life**
Type of polymer	HD poly(ethene)	LD poly(ethene)
Raw material from which polymer is made	Crude oil	Crude oil
Mass of waste material per bag from production in grams	0.42	0.17
Mass of carbon dioxide emitted per bag during production and transport in grams	1.6	6.9
Mean number of times used	1	6
Possible disposal methods	Landfill Incineration Recycling	Landfill Incineration Recycling

Do not write outside the box

Evaluate the use of each type of carrier bag.

Use data from **Table 1** and your own knowledge.

[6 marks]

6

Turn over for the next question

Do not write outside the box

0 3 Some drinks containers are made from aluminium. Other drinks containers are made from a polymer called PET.

Both aluminium and PET can be recycled.

0 3 . 1 **Figure 3** shows the recycling symbol for PET.

Figure 3

Suggest why this symbol is used on a PET bottle.

[1 mark]

0 3 . 2 50 000 000 kg of aluminium are used each year to make drinks cans.

70% of these aluminium cans are recycled.

Calculate the mass of aluminium that is recycled each year from drinks cans.

Give your answer in standard form.

[3 marks]

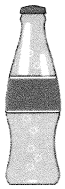
Mass = _____ kg

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 **Table 1** gives information about the Life Cycle Assessments (LCAs) of two types of drinks containers.

Table 1

	Aluminium can	**PET bottle**
		
Raw material	Aluminium ore	Crude oil
Energy to **process** raw material to produce 1 kg of aluminium / PET in J	210 000 000	84 000 000
Volume of can / bottle in cm^3	330	330
Mass of can / bottle in g	20	20
Energy to **manufacture** 1 kg of cans from aluminium in J	2 600 000	
Energy to **manufacture** 1 kg of bottles from PET in J		9 800 000
Percentage of cans / bottles recycled	70%	24%
Use of materials from recycled cans / bottles	To produce aluminium cans	Mainly used as PET fibres in carpets and clothing

Do not write outside the box

Evaluate the use of aluminium compared with the use of PET for drinks containers.

Your answer should include supporting calculations.

[6 marks]

10

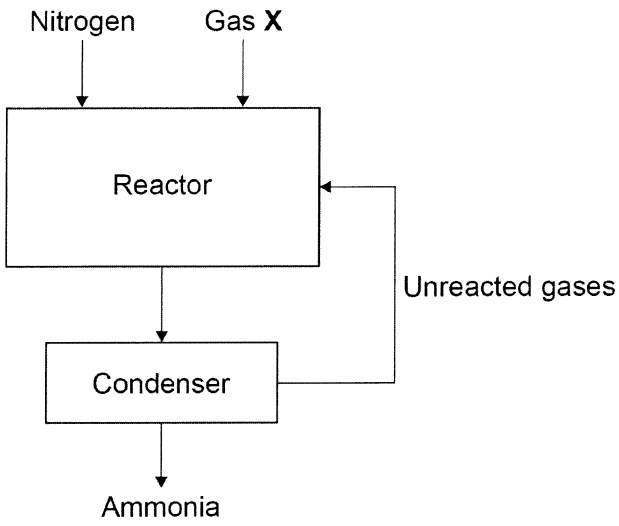
Turn over for the next question

Do not write outside the box

0 3 This question is about gases.

Figure 3 shows how nitrogen is used in the Haber Process to produce ammonia.

Figure 3



0 3 . 1 Gas **X** in **Figure 3** is obtained from methane.

Name gas **X**.

[1 mark]

_____

0 3 . 2 Give the approximate temperature and pressure used in the reactor.

[2 marks]

Temperature _____

Pressure _____

0 3 . 3 The mixture of gases from the reactor cools in the condenser.

Suggest why ammonia condenses but the other gases do not.

[1 mark]

_____

_____

Turn over ▶

Do not write outside the box

The Earth's early atmosphere was different to Earth's atmosphere today.

Scientists think that the Earth's early atmosphere was like the atmosphere found on Venus today.

Table 2 shows the amounts of carbon dioxide and oxygen in the atmospheres of Venus and Earth today.

Table 2

Gas	Percentage (%) in Venus' atmosphere today	Percentage (%) in Earth's atmosphere today
Carbon dioxide	96.50	0.04
Oxygen	0.00	20.95

0 3 . 4 The percentages of carbon dioxide and oxygen have changed from Earth's early atmosphere to Earth's atmosphere today.

Explain the processes that led to these changes.

[6 marks]

Do not write outside the box

0 3 . 5 Why are scientists **not** certain about the percentage of each gas in the Earth's early atmosphere?

[1 mark]

11

Turn over for the next question

Do not write outside the box

0 3 A student investigated the mass of dissolved solids in 5 cm^3 samples of water.

Figure 3 shows the apparatus.

Figure 3

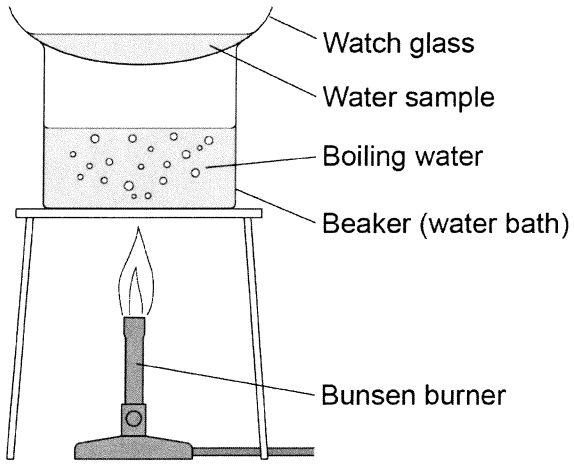


Table 2 shows the student's results.

Table 2

Type of water	Mass in g			
	Watch glass	**Watch glass and dissolved solids**	**Dissolved solids in 5 cm^3 of water**	**Dissolved solids in 1000 cm^3 of water**
Sea water	9.34	9.48	0.14	28.00
River water	9.15	9.23	0.08	**X**
Rainwater	8.93	8.93	0.00	0.00

0 3 . 1 Calculate mass **X** in **Table 2**

[1 mark]

Mass **X** = _____ g

Do not write outside the box

0 3 . 2 5 cm^3 is a small volume of water for each experiment.

Give **one** advantage and **one** disadvantage of using a larger volume.

[2 marks]

Advantage _____

_____

Disadvantage _____

_____

0 3 . 3 Potable water is **not** pure water.

Describe the difference between potable water and pure water.

[1 mark]

_____

_____

_____

0 3 . 4 Potable water is obtained from both groundwater **and** from sea water.

Describe how groundwater and sea water are treated to produce potable water.

[3 marks]

_____

_____

_____

_____

_____

_____

Question 3 continues on the next page

Do not write outside the box

0 3 . 5 The percentage by mass of dissolved solids in a 6.50 g sample is 2.2%

Calculate the mass of the dissolved solids.

[2 marks]

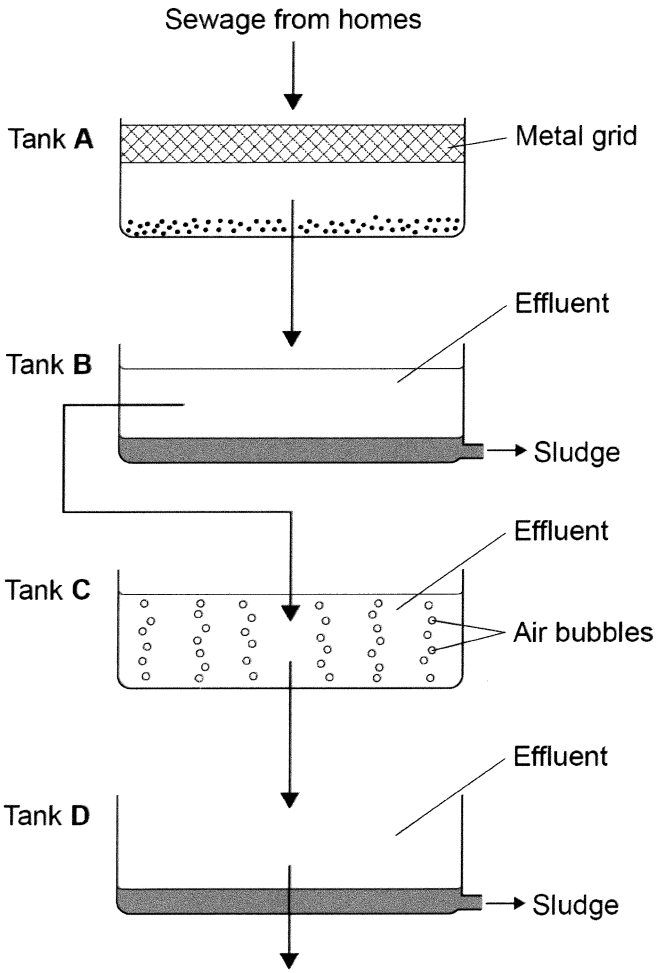
Mass of dissolved solids = _____ g

9

Do not write outside the box

0 4 **Figure 4** shows part of the process of sewage treatment.

Figure 4



0 4 . 1 Name the **two** processes happening in tank **A**.

[2 marks]

1 _____

2 _____

Do not write outside the box

0 4 . 2 Explain the processes happening in tank **C**.

[4 marks]

0 4 . 3 The water from tank **D** is sterilised.

Why is the water from tank **D** sterilised?

[1 mark]

0 4 . 4 Seawater can be desalinated by distillation.

Name **one** other method of desalination.

[1 mark]

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 Describe a method to measure the concentration of dissolved solids in a sample of seawater.

[6 marks]

14

Do not write outside the box

1 0 Disposable cups are made from coated paper or poly(styrene).

Table 6 shows information on the life cycle assessments (LCAs) of disposable cups.

Table 6

	Coated paper cups	Poly(styrene) cups
Raw materials	Wood	Crude oil
Mass of 1 cup in g	8.3	1.9
Energy to produce 1 cup in kJ	550	200
Energy released when 1 cup is burned in kJ	166	76
Biodegradable	Yes	No
Recyclable	No	Yes

1 0 . 1 Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use **Table 6** and your knowledge and understanding of LCAs.

[6 marks]

Do not write outside the box

10.2 Calculate the energy needed to produce 1.00 kg of coated paper cups.

Use **Table 6**.

Give your answer in standard form.

[2 marks]

Energy = _____ kJ

10.3 Melamine is a polymer used to make non-disposable cups.

Melamine does **not** melt when it is heated.

Explain why.

[2 marks]

10

END OF QUESTIONS

Do not write outside the box

0 4 This question is about copper and fuels.

0 4 . 1 Copper is extracted from low-grade ores by phytomining.

Describe how copper metal is produced by phytomining.

[4 marks]

0 4 . 2 Another method of extracting copper from low-grade ores is bioleaching.

A solution of copper sulfate ($CuSO_4$) produced by bioleaching has a concentration of 0.319 g/dm^3

Relative atomic masses (A_r): Cu = 63.5 O = 16 S = 32

Calculate the number of moles of copper that can be produced from 1 dm^3 of this solution.

[3 marks]

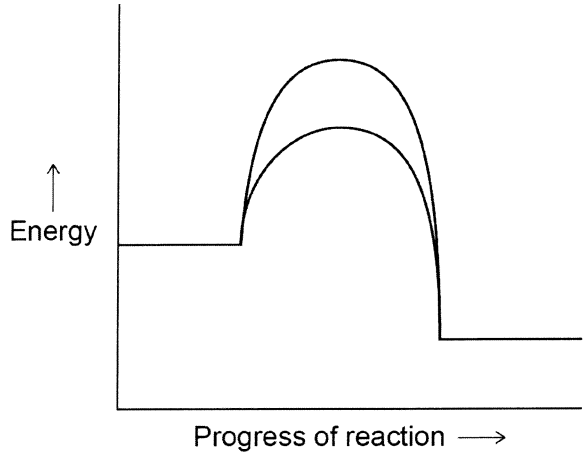
Number of moles of copper = _____ mol

Do not write outside the box

Copper is used as a catalyst.

Figure 1 shows reaction profiles for a reaction with and without a catalyst.

Figure 1



0 4 . 3 How do the reaction profiles show that using a catalyst does **not** affect the overall energy change for the reaction?

[1 mark]

Tick (✓) **one** box.

Both reaction profiles show exothermic reactions. ☐

Both reaction profiles start at the same energy level and end at the same energy level. ☐

Both reaction profiles show the activation energy. ☐

The activation energy for the uncatalysed reaction is much lower than for the catalysed reaction. ☐

Do not write outside the box

0 4 . 4 Copper is a catalyst in a reaction to produce ethanol from carbon dioxide.

Ethanol (C_2H_5OH) is used as a fuel.

Suggest why producing ethanol from carbon dioxide is sustainable.

[2 marks]

0 4 . 5 Chemistry plays an important role in sustainable development.

What is sustainable development?

[2 marks]

12

Turn over for the next question

Do not write outside the box

0 4 This question is about the corrosion of metals.

The corrosion of iron is called rusting.

0 4 . 1 A student investigated the rusting of iron.

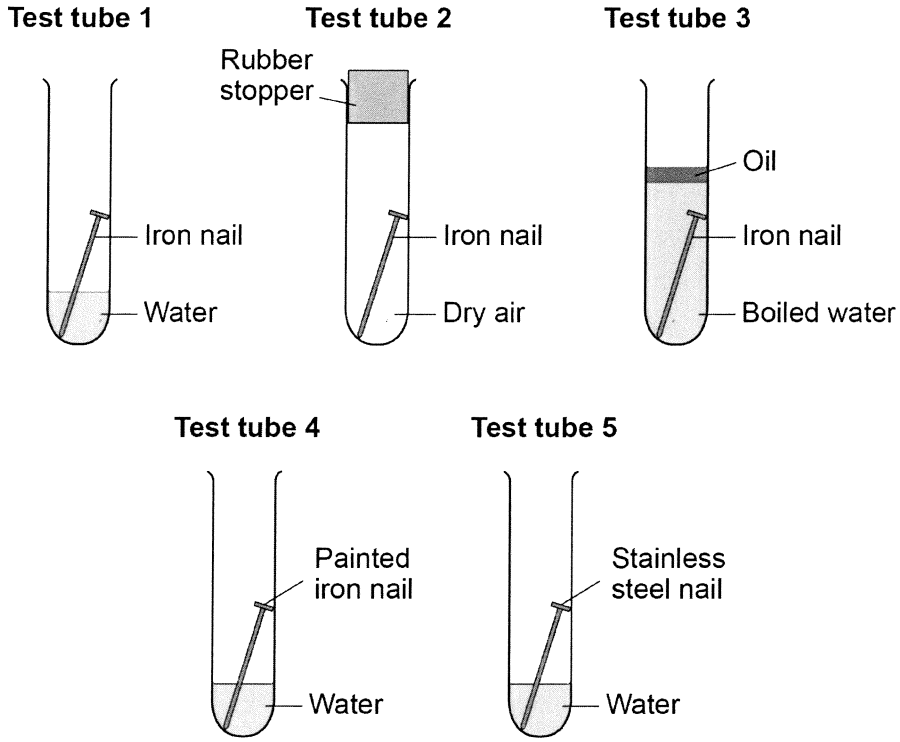
This is the method used.

1. Set up the test tubes as shown in **Figure 4**.

2. Leave the test tubes for 1 week.

3. Examine the nails for signs of rust.

Figure 4



Explain what would happen to the nails in each of the test tubes.

[5 marks]

Do not write outside the box

0 4 . 2 Magnesium is fixed to some steel ships.

Explain how this prevents the steel from rusting.

[2 marks]

0 4 . 3 Explain why aluminium window frames do **not** corrode after they are made.

[2 marks]

9

Do not write outside the box

0 6 Copper can be extracted using biological methods.

0 6 . 1 Name **two** biological methods used to extract copper from copper ores.

For each method, name the type of organism used in the process.

[4 marks]

Method 1 _____

Type of organism _____

Method 2 _____

Type of organism _____

0 6 . 2 Give **three** reasons why biological methods are being introduced to extract copper.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

Do not write outside the box

The biological methods produce copper compounds such as copper sulfate.

0 6 . 3 Copper can be extracted from copper sulfate solution by adding scrap iron.

Explain why.

[2 marks]

0 6 . 4 Complete the chemical equation for the reaction between iron and copper sulfate solution.

[2 marks]

Include state symbols.

_____(__) + $CuSO_4$(__) → _____(__) + _____(aq)

0 6 . 5 A solution of copper sulfate contains 3.175 g of copper ions.

Calculate the number of copper ions in the solution.

Give your answer in standard form.

Relative atomic mass (A_r): Cu = 63.5

The Avogadro constant is 6.02×10^{23} per mole.

[4 marks]

Number of copper ions = _____

15

Do not write outside the box

1 0 This question is about reversible reactions and equilibrium.

Hydrogen is used to produce ammonia in the Haber process.

The hydrogen is made in two stages.

Stage 1 is the reaction of methane and steam to produce carbon monoxide and hydrogen.

The equation for the reaction is:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

1 0 . 1 Calculate the atom economy for the formation of hydrogen in **stage 1**.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

Atom economy = _____ %

Do not write outside the box

1 0 . 2 Explain why a low pressure is used in **stage 1**.

Give your answer in terms of equilibrium.

[2 marks]

1 0 . 3 **Stage 2** uses the carbon monoxide produced in **stage 1**.

The carbon monoxide is reacted with more steam to produce carbon dioxide and more hydrogen.

The equation for the reaction in **stage 2** is:

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

What is the effect of increasing the pressure on the equilibrium yield of hydrogen in **stage 2**?

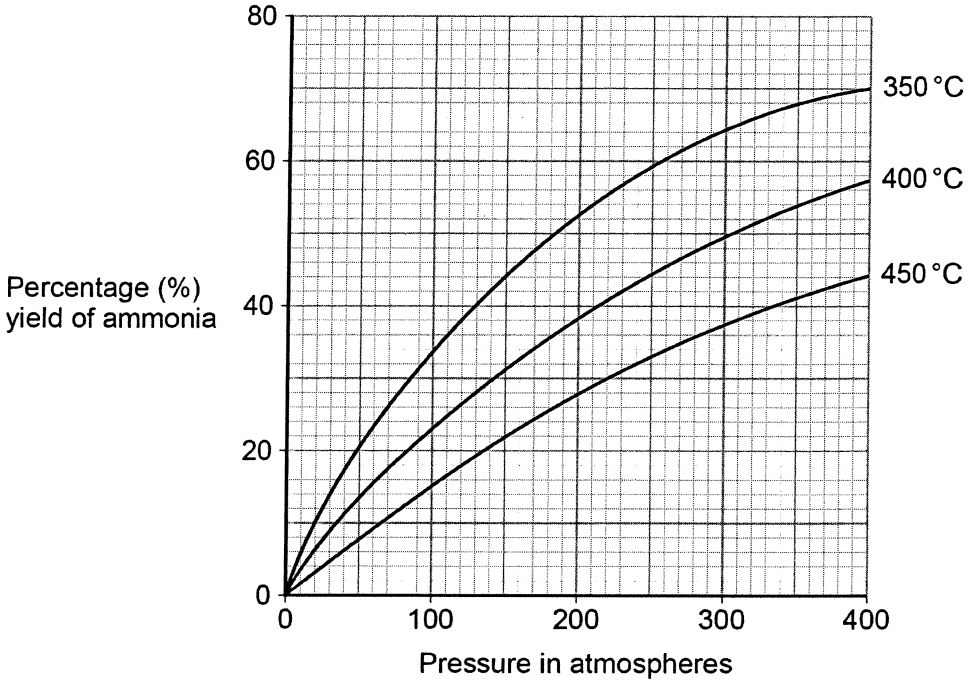
[1 mark]

Question 10 continues on the next page

Do not write outside the box

Figure 10 shows the percentage yield of ammonia produced at different temperatures and pressures in the Haber process.

Figure 10



A temperature of 450 °C and a pressure of 200 atmospheres are used in the Haber process.

1 0 . 4 A student suggested that a temperature of 350 °C and a pressure of 285 atmospheres could be used instead of those used in the Haber process.

Determine how many times greater the percentage yield of ammonia obtained would be.

Use **Figure 10**.

[3 marks]

Percentage yield = _____ times greater

Do not write outside the box

1 0 . 5 A pressure of 285 atmospheres is **not** used in the Haber process instead of 200 atmospheres.

Give **one** reason why.

[1 mark]

1 0 . 6 How does **Figure 10** show that the forward reaction in the Haber process is exothermic?

[1 mark]

1 0 . 7 World production of ammonia is now about 30 times greater than it was in 1950.

Suggest why the demand for ammonia has increased.

[2 marks]

12

END OF QUESTIONS