

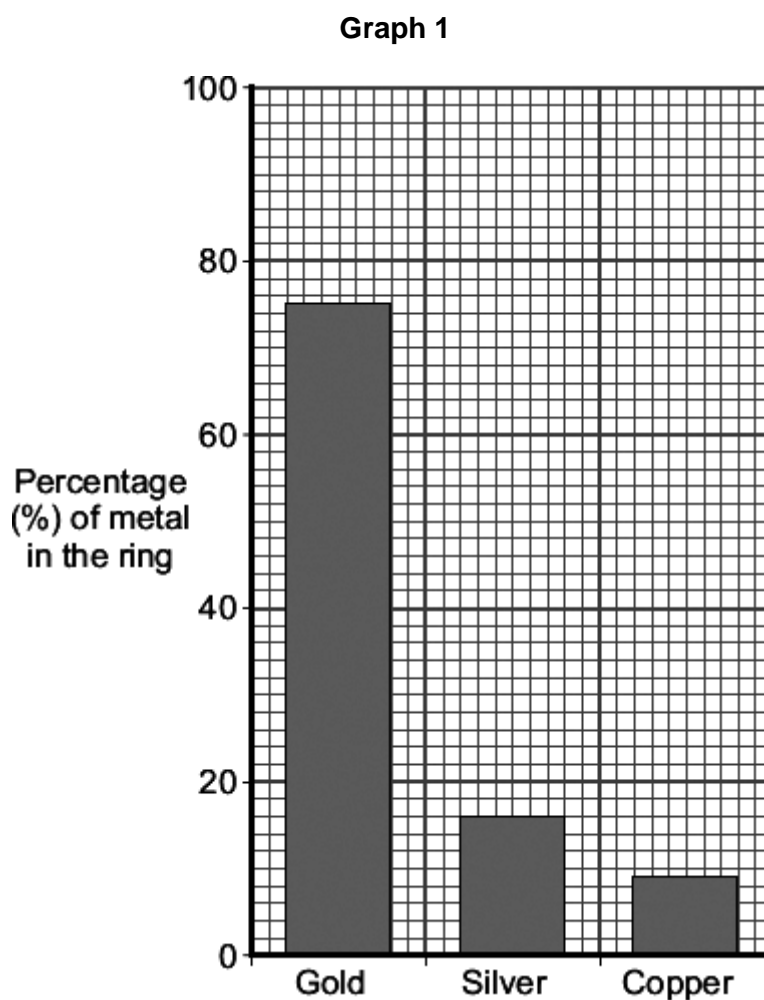
4-10 – Using resources – Chemistry

1.0 The picture shows a ring.



Photograph supplied by Comstock/Thinkstock

1.1 **Graph 1** shows the composition of the metals in the ring.



The metal in the ring had a mass of 8.5g. What was the mass of gold in the ring?  
Give your answer to 2 significant figures.

[3 marks]

Mass = \_\_\_\_\_ g

1.2 Give **two** reasons why other metals are added to gold to make the ring.

[2 marks]

---

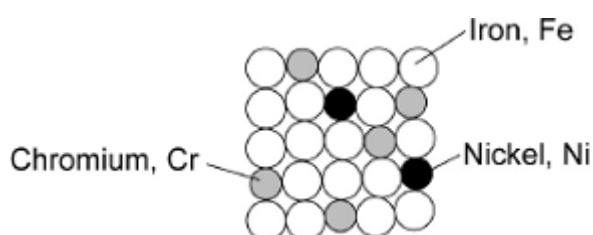


---

1.3 Stainless steel is an alloy of iron, chromium and nickel.

**Figure 1** represents the particles in stainless steel.

**Figure 1**



Particle diagram of stainless steel

Calculate the percentage (%) of chromium in stainless steel.  
Use information from **Figure 1**.

[2 marks]

Percentage (%) of chromium in stainless steel = \_\_\_\_\_ %

1.4 Different types of steel have different properties.

Draw **one** line from each type of steel to its properties.

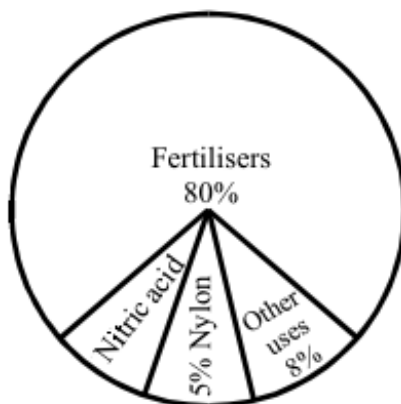
[1 mark]

type of steel	property
High carbon	Hard and resistant to corrosion
Low carbon	Soft and easy to shape
Stainless steel	Strong but brittle

2.0 Ammonia is an important chemical. Ammonia is used to make other substances.

Figure 2 shows substances made from ammonia.

Figure 2



2.1 131 million tonnes of ammonia are produced each year.  
Calculate the amount of ammonia used to make nitric acid.

[3 marks]

\_\_\_\_\_ million tonnes

2.2 Ammonia is an alkali in solution.

What type of reaction takes place when ammonia solution reacts with nitric acid?

[1 mark]

\_\_\_\_\_

2.3 Much of the nitric acid produced is then reacted with ammonia to make a salt which is used as a fertiliser.

Name the salt produced by reacting ammonia with nitric acid.

[1 mark]

\_\_\_\_\_

2.4 The reaction between ammonia and nitric acid produces a single product.

The chemical formula of ammonia is  $\text{NH}_3$ .

Write a balanced symbol equation for ammonia and nitric acid.

[2 marks]



3.1 What does 'potable water' mean?

[1 mark]

---



---

3.2 How is 'potable water' different to 'pure water'?

[1 mark]

---



---

3.3 Name **two** ways of sterilising water.

[2 marks]

1 \_\_\_\_\_

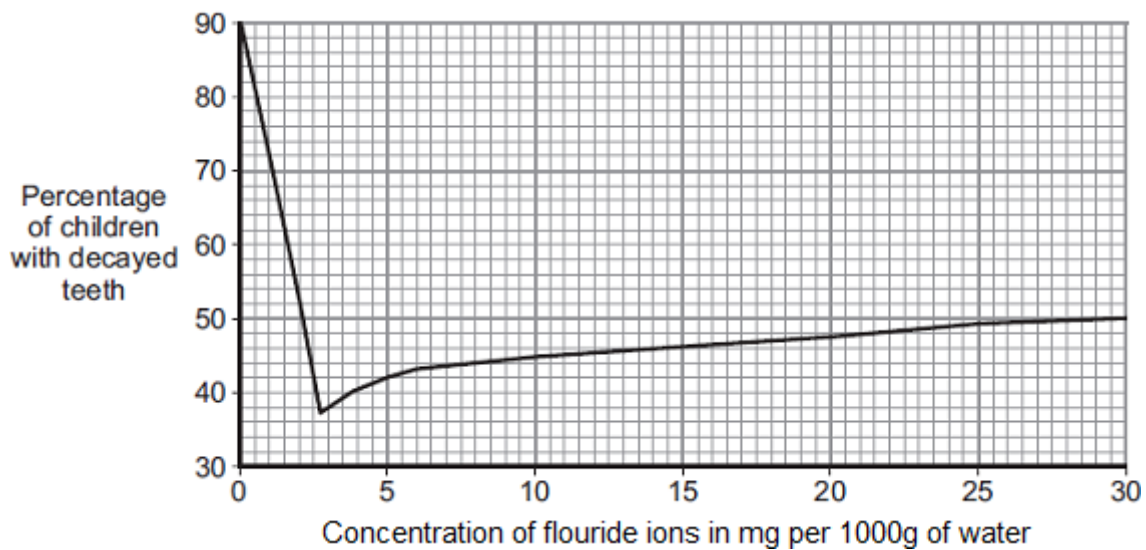
2 \_\_\_\_\_

Compounds containing fluoride ions are added to some drinking water supplies.

Scientists investigated the effect of fluoride ions on tooth decay.

**Graph 2** shows the concentration of fluoride ions against the percentage of children with decayed teeth.

**Graph 2**



**3.4** Suggest the best concentration of fluoride ions to use in drinking water.  
Give **a** reason for your answer.

**[2 marks]**

Best concentration = \_\_\_\_\_ mg per 1000g water

Reason: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**3.5** Describe two patterns shown by **Graph 2**.

**[2 marks]**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**4.0** Desalination of seawater can be carried out by processes that use membranes such as reverse osmosis.

**4.1** Describe one **other** way to desalinate sea water in a school laboratory.

You may include a labelled diagram in your answer.

**[4 marks]**

---

---

---

---

---

---

---

---

---

---

**4.2** A student investigated how much solid was dissolved in sea water.

The student:

1. Measured the mass of an empty evaporating basin.
2. Measured 50 cm<sup>3</sup> of sea water and poured it into the evaporating basin.
3. Heated the evaporating basin gently until all of the water had evaporated.
4. Measured the mass of the evaporating basin containing the solid residue.
5. Reheated the evaporating basin and solid residue.
6. Measured the mass of the evaporating basin and solid residue.
7. Repeated steps 5 and 6 until the mass was constant.

Name two different pieces of apparatus that would be suitable for measuring:

- the mass of the evaporating basin
- 50 cm<sup>3</sup> of sea water.

**[2 marks]**

Equipment to measure the mass of the evaporating basin \_\_\_\_\_

Equipment to measure 50 cm<sup>3</sup> of sea water \_\_\_\_\_

**4.3** Why did the student keep reheating the evaporating basin and solid residue until a constant mass was obtained?

[1 mark]

---

---

**4.4** The results the student obtained using 50 cm<sup>3</sup> of sea water are:

mass of empty evaporating basin = 23.57 g

mass of evaporating basin and dry solid residue = 25.23 g

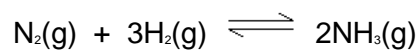
Calculate the mass of solid dissolved in **1000 cm<sup>3</sup>** of the sea water.

[1 mark]

Mass dissolved in 1000 cm<sup>3</sup> = \_\_\_\_\_ g

5.0 The Haber process is used to make ammonia (NH<sub>3</sub>).

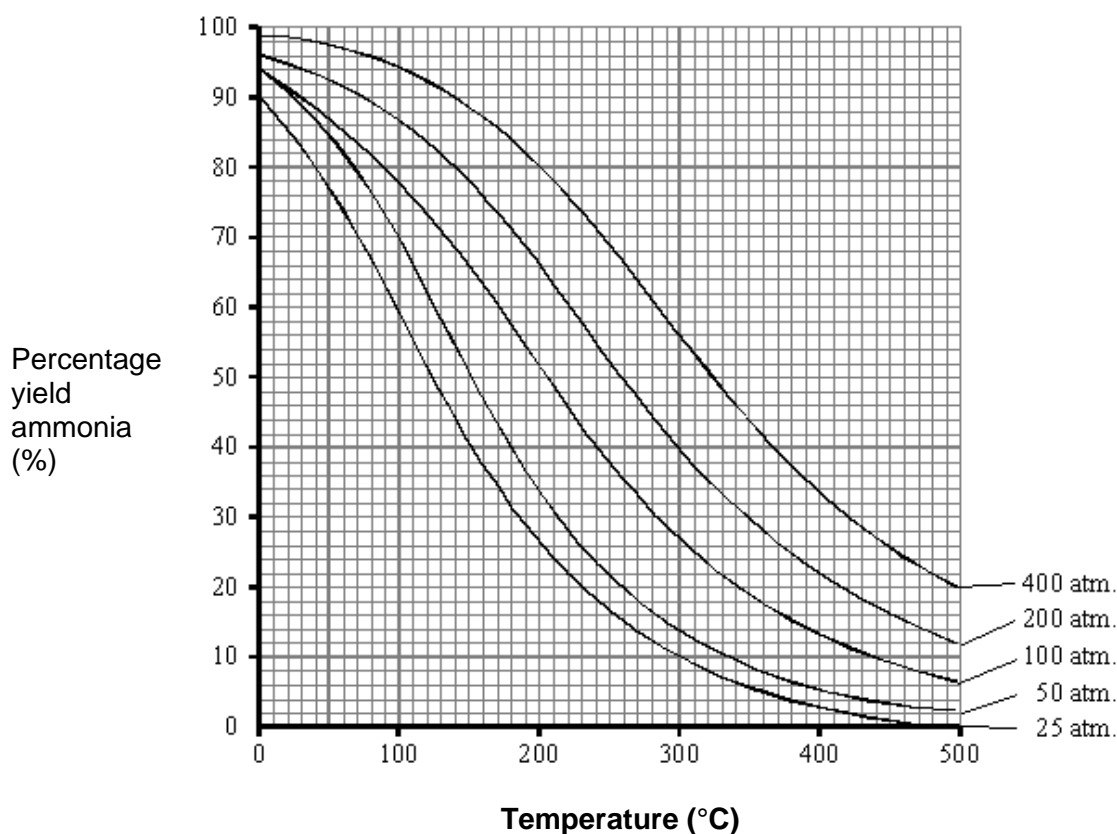
The equation shows the reaction:



The reaction is exothermic.

**Graph 3** shows how the temperature and pressure affect the percentage of ammonia produced in the reaction.

**Graph 3**



5.1 The usual reaction conditions for making ammonia are 450 °C and 200 atmospheres.

Which change has the greatest effect:

- reducing the temperature to 300 °C or
- doubling the pressure to 400 atmospheres?

Explain your answer.

[2 marks]

---



---



---







MARK SCHEME

Qu No.		Extra Information	Marks									
1.1	Percentage gold = 75% $8.5 \times 0.75 = 6.375$ = 6.4 to 2 significant figures	Allow ecf from first marking point	1 1 1									
1.2	Any <b>two</b> from: <ul style="list-style-type: none"> <li>(100% / pure) gold is soft</li> <li>(alloyed) to make the metal hard(er)</li> <li>gold is expensive or alloy is less expensive</li> </ul>	Ignore references to colour / lustre / corrosion / rarity  Allow (alloyed) to make the metal strong	2									
1.3	$\frac{5}{25}$ 20 (%)	Allow an answer of 20 (%) without working for two marks	1 1									
1.4	<table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 25%;">High carbon</td> <td style="width: 25%;"></td> <td style="width: 25%;">Hard and resistant to corrosion</td> </tr> <tr> <td>Low carbon</td> <td style="border: none;">X</td> <td>Soft and easy to shape</td> </tr> <tr> <td>Stainless steel</td> <td style="border: none;">X</td> <td>Strong but brittle</td> </tr> </table>	High carbon		Hard and resistant to corrosion	Low carbon	X	Soft and easy to shape	Stainless steel	X	Strong but brittle	All required for the mark	1
High carbon		Hard and resistant to corrosion										
Low carbon	X	Soft and easy to shape										
Stainless steel	X	Strong but brittle										

Qu No.		Extra Information	Marks
2.1	100-80-8-5 = 7% nitric acid $131 \times 0.07$ = 9.17		1 1 1
2.2	Neutralization		1
2.3	Ammonium nitrate		1
2.4	HNO <sub>3</sub> NH <sub>4</sub> NO <sub>3</sub>		1 1

Qu No.		Extra Information	Marks
3.1	Water that is fit/safe to drink		1
3.2	Pure water contains only molecules of water	Allow potable water contains low levels of dissolved salts	1
3.3	Any <b>two</b> from: <ul style="list-style-type: none"> <li>• chlorine</li> <li>• ozone</li> <li>• ultraviolet / uv light</li> <li>• distillation</li> </ul>	Ignore filtration and reverse osmosis  If two answers together on one line, apply list rule.	2
3.4	2.75 (mg per 1000 g of water) As this has the greatest effect on tooth decay	Allow answers in range 2.5 – 3.0	1
		Allow lowest rate of tooth decay	1
3.5	As the percentage of fluoride ions increases the number of children with tooth decay decreases until the fluoride ion concentration is 2.75 (mg per 1000 g of water)  After a fluoride ion concentration of 2.75 (mg per 1000 g of water), the number of children with tooth decay increases as the fluoride ion concentration increases	Allow ecf in value from 3.5	1
		Allow as the percentage of fluoride ions increases initially the number of children with tooth decay decreases	1

Qu No.		Extra Information	Marks
4.1	Distillation Heat a flask (containing sea water) until it boils Use of a condenser / delivery tube Collect (pure water) in a boiling tube / beaker / flask		1
		Allow evaporate sea water.	1
			1
			1
		The last three marks can be obtained from a suitably labelled diagram.	
4.2	(Top pan) balance Measuring cylinder		1
			1
4.3	To make sure that all of the water had evaporated		1
4.4	33.2 (g)		1

Qu No.		Extra Information	Marks
5.1	Usual conditions give yield of 16 (%)	Award second mark for one other reading from the graph and a valid conclusion.	1
	Reducing temperature gives yield of 40(%) / Increasing pressure gives yield of 24(%) so reducing temperature has greater effect		1
5.2			
<b>Level 3:</b>	A detailed and coherent explanation is given, which demonstrates a broad understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.		5-6
<b>Level 2:</b>	An explanation is given which demonstrates a reasonable understanding of the key scientific ideas. Links are made but may not be fully articulated and / or precise.		3-4
<b>Level 1:</b>	Simple statements are made which demonstrate a basic understanding of some of the relevant ideas. The response may fail to make logical links between the points raised.		1-2
	No relevant content		0
<b>Indicative content</b>			
	<ul style="list-style-type: none"> <li>The best <b>yield</b> is obtained at high pressure and low temperature.</li> <li>It is a reversible reaction.</li> <li>Formation of ammonia is favoured at low temperature.</li> <li>(Because) the reaction is exothermic.</li> <li>Formation of ammonia is favoured at high pressure.</li> <li>Because greater number of gaseous reactant molecules than gaseous product molecules or because greater volume of reactant molecules than product molecules.</li> <li>Pressure used is limited by cost/materials.</li> <li>Rate of reaction slow at low temperatures.</li> <li>Actual temperature and pressure used is a good compromise between a good yield and reasonable rate.</li> <li>Removal of ammonia makes rate more important than yield.</li> </ul>		

Qu No.		Extra Information	Marks
6.1	Grow plants on land containing copper ores, then burn the plants		1
	Ash (from burning) contains copper compounds		1
6.2			
<b>Level 3:</b>	A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.		5-6
<b>Level 2:</b>	A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.		3-4
<b>Level 1:</b>	Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.		1-2
	No relevant content		0
<b>Indicative content</b>			
<p>Extraction from bauxite</p> <ul style="list-style-type: none"> <li>• High temperature needed to melt bauxite/ore;</li> <li>• Large amount of electricity used;</li> <li>• <u>Higher</u> energy costs;</li> <li>• Uses more natural resources;</li> <li>• Bauxite must be quarried so more damage to the environment;</li> <li>• Purity of aluminium produced is <u>higher</u>.</li> </ul> <p>Recycling</p> <ul style="list-style-type: none"> <li>• Reduces waste going to landfill;</li> <li>• Uses less natural resources;</li> <li>• Lower energy costs;</li> <li>• Aluminium must be separated from other materials;</li> <li>• Purity of aluminium is lower.</li> </ul>			