The Morley Academy

11. Using our Resources (GCSE CHEM ONLY) Mastery Booklet

(Chemistry Paper 2)

Name : _____

Teacher : _____

Date Given : _____

These booklets are a consolidation of your learning. They should be used in the following way - You should attempt the questions WITHOUT looking at the answers. Then mark your questions with **green pen** and add any missing marks you missed.

THESE BOOKLETS WILL IMPROVE YOUR GRADES...!!

Q1.

The Haber Process is used to produce ammonia from nitrogen and hydrogen.

The equation for the reaction is:

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

(a) An ammonia molecule has the formula NH_3

How many atoms are there in one molecule of ammonia?

Tick (✔) **one** box.

2 ☐ 3 ☐ 4 ☐ 6 ☐

(1)

(b) What does the symbol ⇌ mean?

_____

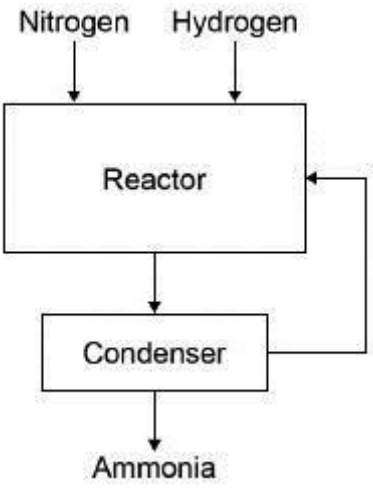
(1)

(c) Draw **one** line from each gas to the source of that gas.

Gas	Source
	Air
Hydrogen	Alcohol
	Ammonia
Nitrogen	Iron
	Natural gas

(2)

The diagram shows the Haber process.



A mixture of ammonia, hydrogen and nitrogen gases leave the reactor.

Table 1 shows the boiling points of the gases.

Table 1

Gas	Boiling point in °C
Ammonia	– 33
Nitrogen	– 196
Hydrogen	– 253

(d) The mixture is cooled to a temperature at which **only** the ammonia condenses to a liquid.

Which temperature could be used?

Tick (✔) **one** box.

− 20 °C ☐

− 40 °C ☐

− 200 °C ☐

− 260 °C ☐

(1)

(e) What happens to the unreacted nitrogen?

Tick (✔) **one** box.

Collected and sold ☐

Recycled to the reactor ☐

Released into the air ☐

Used as a catalyst ☐

(1)

Ammonia from the Haber process can be used to produce fertilisers.

Table 2 gives information about two compounds used in fertilisers.

Table 2

Fertiliser	Compound	Cost in £ / kg
A	Potassium chloride	0.24
B	Diammonium phosphate	0.35

(f) What type of bonding is present in potassium chloride?

Tick (✔) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

(g) Diammonium phosphate has the chemical formula $(NH_4)_2HPO_4$

Which **two** elements in $(NH_4)_2HPO_4$ improve agricultural productivity?

Tick (✔) **two** boxes.

- Chlorine ☐
- Hydrogen ☐
- Nitrogen ☐
- Oxygen ☐
- Phosphorus ☐

A farmer uses fertilisers **A** and **B** on a field with an area of 0.05 km^2

(2)

(h) 50 kg of fertiliser A will cover an area of 0.01 km^2

Calculate the cost of fertilising a field with an area of 0.05 km^2 with fertiliser **A**.

Use **Table 2**.

_____

_____

Cost = £ _____

(2)

(i) Fertiliser **B** is more expensive than fertiliser **A**.

Suggest why the farmer uses **both** fertilisers.

_____

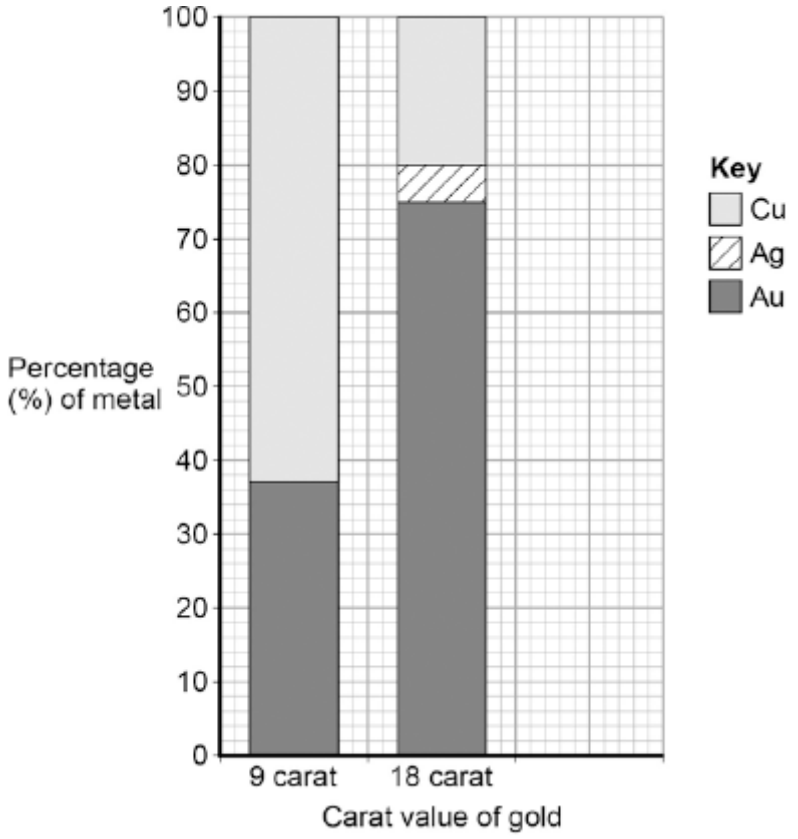
(1)

(Total 12 marks)

Q2.

Gold is mixed with other metals to make jewellery.

The figure below shows the composition of different carat values of gold.



(a) What is the percentage of gold in 12 carat gold?

Tick **one** box.

12 % ☐ **30 %** ☐ **50 %** ☐ **80 %** ☐

(1)

(b) Give the percentage of silver in 18 carat gold.

Use the figure above to answer this question.

Percentage = _____ %

(1)

(c) Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

1. _____

_____

2. _____

_____

(2)

(Total 4 marks)

Q3.

(a) PEX is a material that is used as an alternative to copper for hot water pipes.
PEX is made from poly(ethene).

(i) Describe how ethene forms poly(ethene).

_____

_____

_____

_____

(2)

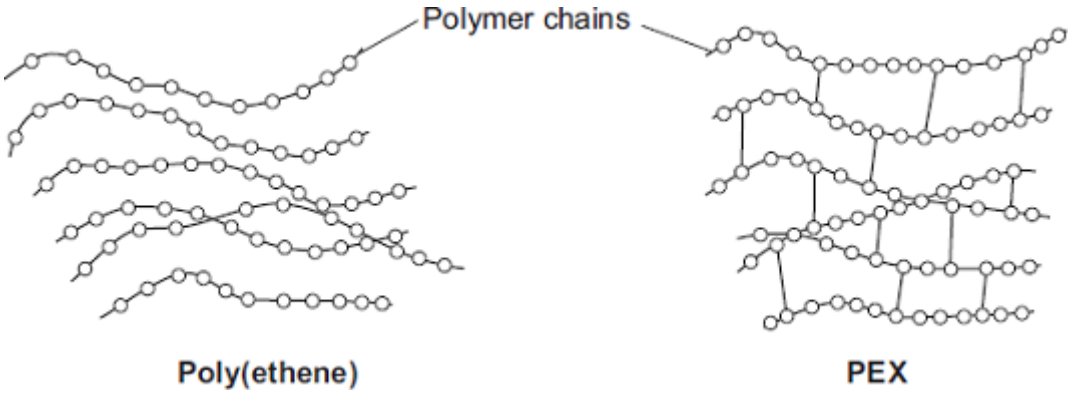
(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

_____

_____

(1)

(iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

_____

_____

_____

_____

_____

_____

(3)

(b) Copper is a suitable material to use for hot water pipes.
PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

1 The low-grade copper ore is powdered and concentrated.

2 The concentrated powdered copper ore is blown into a furnace with air to produce impure, molten copper. (This furnace is heated to 1100 °C using a hydrocarbon fuel.)

3 Oxygen is blown into the impure, molten copper to remove any sulfur. The molten copper is cast into rectangular slabs.

4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes:

- fractional distillation of crude oil
- cracking of naphtha fraction
- polymerisation of ethene
- conversion of poly(ethene) into PEX.

Use the information above and your knowledge and understanding to suggest possible environmental advantages of using PEX instead of copper for hot water pipes.

_____

_____

_____

_____

_____

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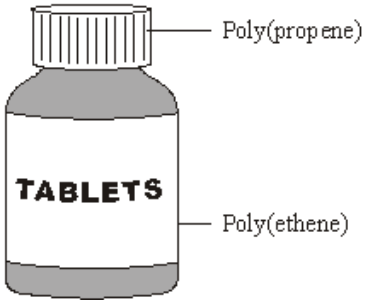
_____

(4)

(Total 10 marks)

Q4.

Tablet containers are often made from two different polymers.



(a) Ethene, C_2H_4, and propene, C_3H_6, can be made from crude oil.

(i) Complete the following sentence.

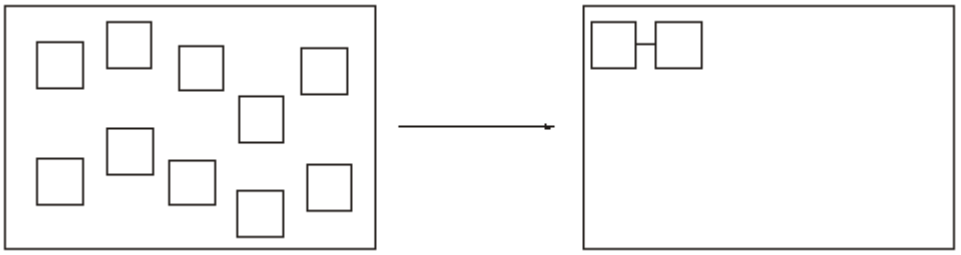
Ethene and propene are called hydrocarbons because they are made up of carbon and _____ atoms only.

(1)

(ii) Ethene molecules are used to form poly(ethene) molecules.

Complete the diagram to show the poly(ethene) molecule.

Ethene molecules **Poly(ethene) molecule**



(2)

(b) The tablet containers could be disposed of in a landfill site or could be recycled.

(i) Suggest **two** reasons why disposing of the tablet containers in a landfill site could cause problems.

1. _____

_____

2. _____

_____

(2)

(ii) Suggest **one** reason why recycling the tablet containers would be difficult.

_____

_____

(1)

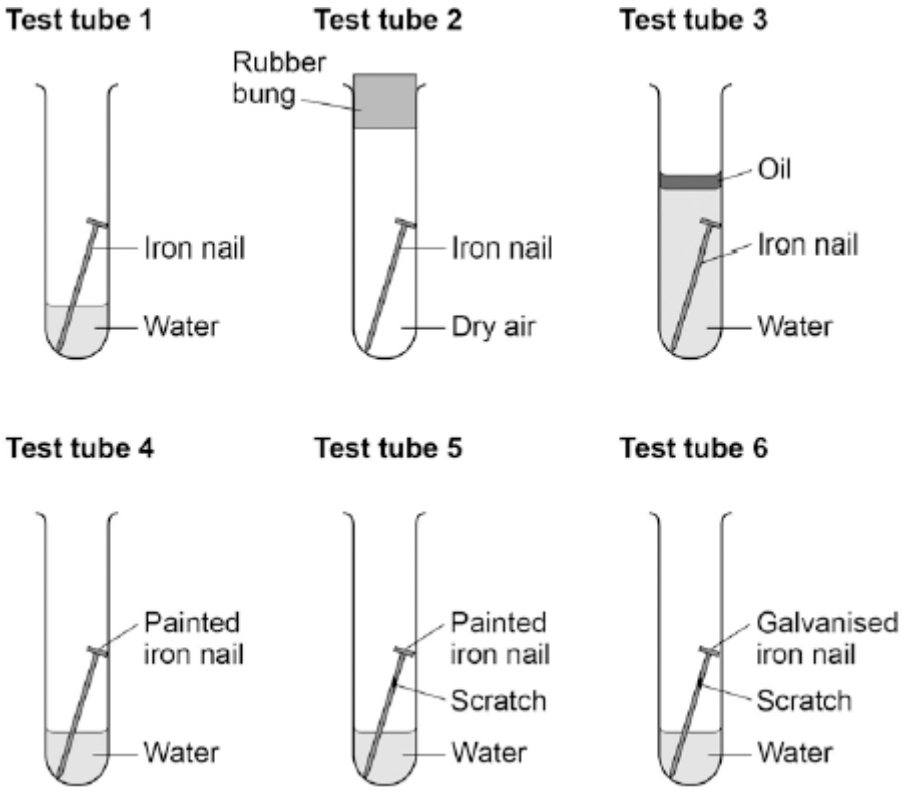
(Total 6 marks)

Q5.

The figure below shows six test tubes a student set up to investigate the rusting of iron.

This is the method used for each test tube.

1. Measure the mass of the nail using a balance.
2. Leave the nail in the test tube for 6 days.
3. Measure the mass of the nail after 6 days.



The table below shows the student's measurements.

Test tube	Mass of nail in g	Mass of nail after 6 days in g
1	8.45	8.91
2	8.46	8.46
3	8.51	8.51
4	9.65	9.65
5	9.37	9.45
6	9.79	9.79

(a) What is the resolution of the balance the student used?

Tick **one** box.

1×10^{-3} g ☐

1×10^{-2} g ☐

1×10^{-1} g ☐

1×10^{2} g ☐

(1)

(b) Calculate the difference in percentage increase in mass after 6 days of the nail in test tube **1** and the nail in test tube **5**.

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

_____

_____

_____

_____

_____

_____

_____

Difference in percentage increase in mass = _____ %

(4)

(c) Use the results of the student's investigations to draw conclusions about the factors affecting the rusting of iron. Include an evaluation of the effectiveness of different coatings at preventing the rusting of iron.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(d) Rust is hydrated iron(III) oxide.

Complete the word equation for the reaction.

_____ + _____ + _____ → hydrated iron(III) oxide

(2)

(Total 13 marks)

Q6.

Gold and gold ions are used as catalysts.

(a) An atom of gold is represented as:

$$^{197}_{79}Au$$

Complete the sentences.

The atomic number of gold is _____

The number of electrons in an atom of gold is _____

(2)

(b) Scientists have found that gold nanoparticles are very good catalysts.

Draw a ring around the correct answer to complete the sentence.

A gold nanoparticle contains a few | hundred / thousand / million | atoms.

(1)

(c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.

$$Au \rightarrow Au^{3+} + 3e^-$$

(i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called _____

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

The number of these particles lost when a gold atom becomes a gold ion is | one. / two. / three. |

(1)

(d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

_____

(1)

(e) Chloroethene can react to make a thermosoftening polymer.

(i) Draw a ring around the correct answer to complete the sentence.

When heated, a thermosoftening polymer will

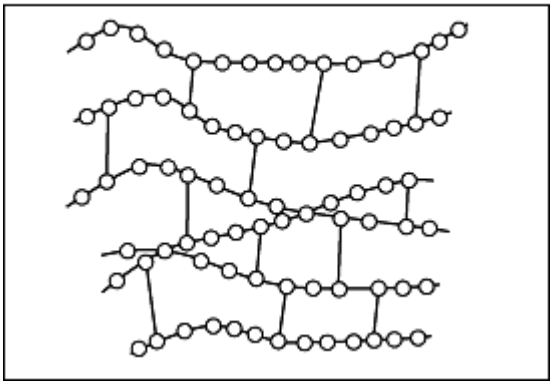
dissolve.
melt.
solidify.

(1)

(ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

_____

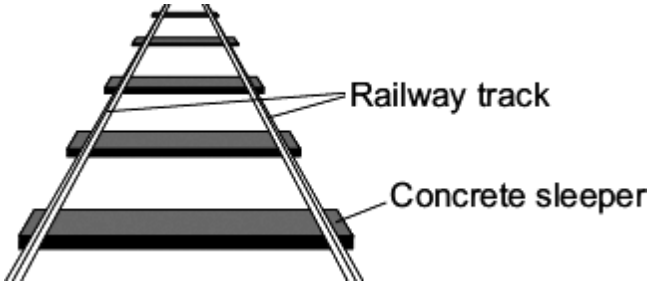
_____

(1)

(Total 8 marks)

Q7.

In the UK, railway sleepers are often made from concrete.

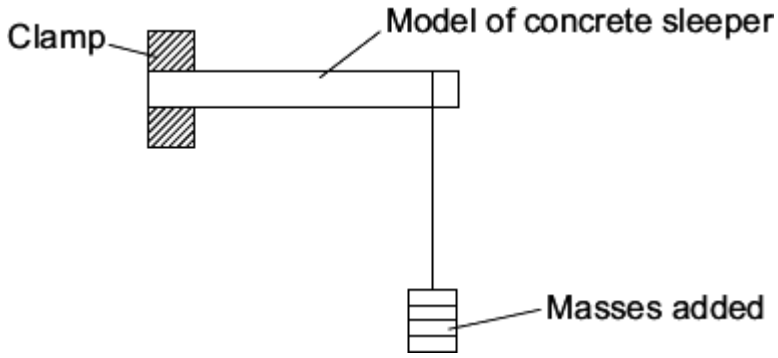


A scientist was asked to find the best concrete mixture to use so that railway sleepers would not

break easily.

The scientist made:

- a mould to make small models of concrete sleepers
- concrete mixtures using crushed rock, sand, cement and water
- the equipment shown to add 0.1 kg masses until the model sleeper broke.



The scientist's results are shown in the table.

Concrete mixture in % by volume			Total mass added to break the model sleeper in kg			
Cement	**Sand**	**Crushed rock**	**Test 1**	**Test 2**	**Test 3**	**Mean**
10	70	20	1.1	1.3	1.2	1.2
20	60	20	2.6	2.5	2.4	
30	50	20	3.3	3.3	3.3	3.3
40	40	20	3.8	4.0	3.3	3.9
50	30	20	4.5	4.2	4.3	4.3

(a) (i) Calculate the mean total mass added to break the model sleeper that has 20% cement by volume.

_____

Mean = _____ kg

(1)

(ii) Choose **one** result in the table that the scientist should check and test again.

Result: % cement by volume _____ Test number _____

Explain why you chose this result.

_____

_____

(2)

(iii) What is the relationship between the total mass to break the model sleeper and the percentage (%) of cement by volume in the concrete mixture?

_____

_____

(1)

(iv) Suggest **one** other variable that the scientist should have recorded in the table of results.

_____

(1)

(b) The scientist thought that full-size railway sleepers should be made from 30% cement, 50% sand and 20% crushed rock.

What other information about these three materials is needed before the scientist recommends using this mixture to make a full-size railway sleeper?

_____

_____

_____

_____

(2)

(Total 7 marks)

Q8.

Iron will rust in damp air.

(a) Iron reacts with water and oxygen to produce rust.

(i) As iron rusts there is a colour change.

Draw a ring around the correct answer to complete the sentence.

During the reaction iron changes from grey to

blue **brown** **green**

(1)

(ii) Rust is hydrated iron oxide.

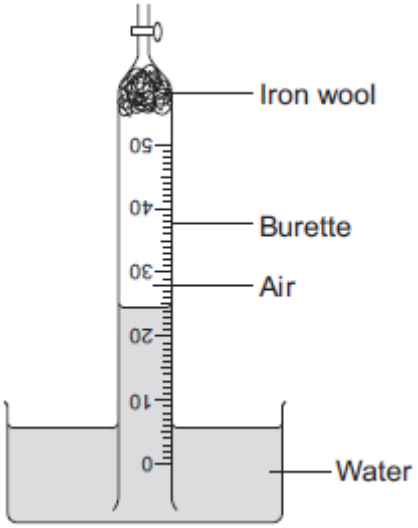
Write a word equation for the reaction of iron with oxygen and water.

_____

(1)

(b) A student set up the apparatus shown in **Figure 1**.

Figure 1

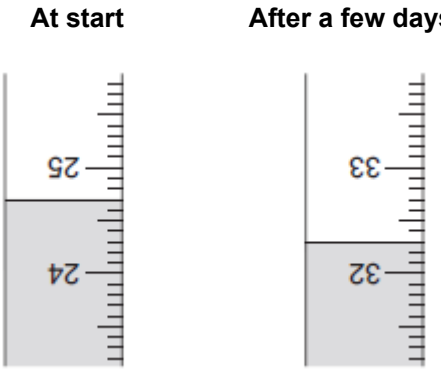


The student left the apparatus for a few days.

The water level in the burette slowly went up and then stopped rising.

Figure 2 shows the water level in the burette at the start of the experiment and after a few days.

Figure 2



(i) Complete the table below to show the reading on the burette after a few days.

Burette reading at start	24.7 cm^3
Burette reading after a few days	_____ cm^3

(1)

(ii) Calculate the volume of oxygen used up in the reaction.

_____

Volume = _____ cm^3

(1)

(iii) The percentage of air that is oxygen can be calculated using the equation:

$$\text{percentage of air that is oxygen} = \frac{\text{volume of oxygen used up}}{\text{volume of air at start}} \times 100$$

The student **cannot** use his results to calculate the correct percentage of air that is oxygen.

Explain why.

_____

_____

_____

_____

_____

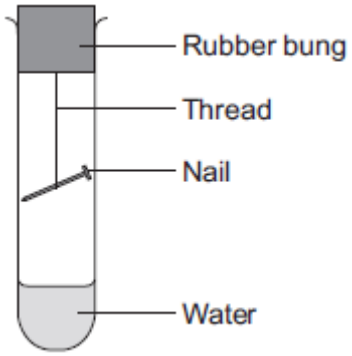
(2)

(c) A student investigated the rusting of an iron nail at different temperatures.

This is the method the student used:

- measure the mass of a nail
- set up apparatus as shown in **Figure 3**
- leave for 3 days
- measure the mass of the rusted nail.

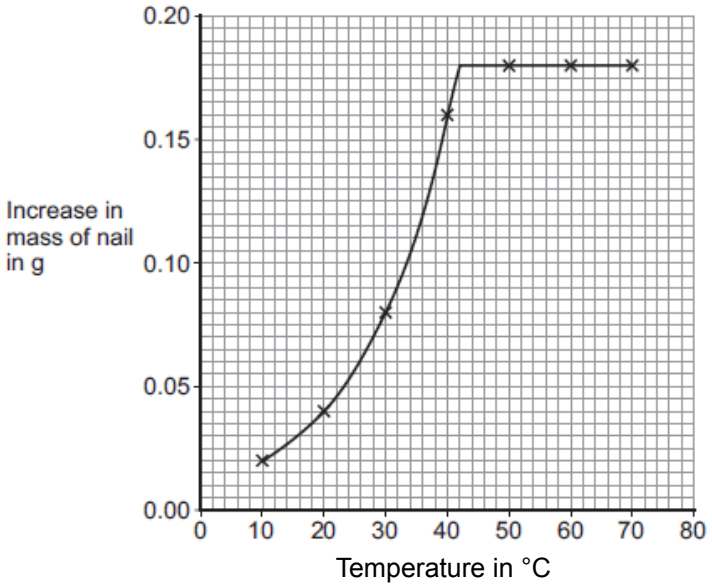
Figure 3



The student repeated the experiment at different temperatures using a new, identical, nail each time.

The student's results are shown on the graph in **Figure 4**.

Figure 4



(i) Why does the mass of the nail increase when it rusts?

_____

_____

(1)

(ii) Use the graph to describe the relationship between the temperature and the increase in mass of the nail.

_____

_____

_____

_____

_____

(3)

(iii) The increase in mass of the nail after 3 days is a measure of the rate of rusting.

The student's graph does **not** correctly show how increasing the temperature above 42 °C changes the rate of rusting.

How could the experiment be changed to show the effect of temperatures above 42 °C on the rate of rusting?

Give a reason for your answer.

_____

_____

_____

_____

(2)

(Total 12 marks)

Q9.

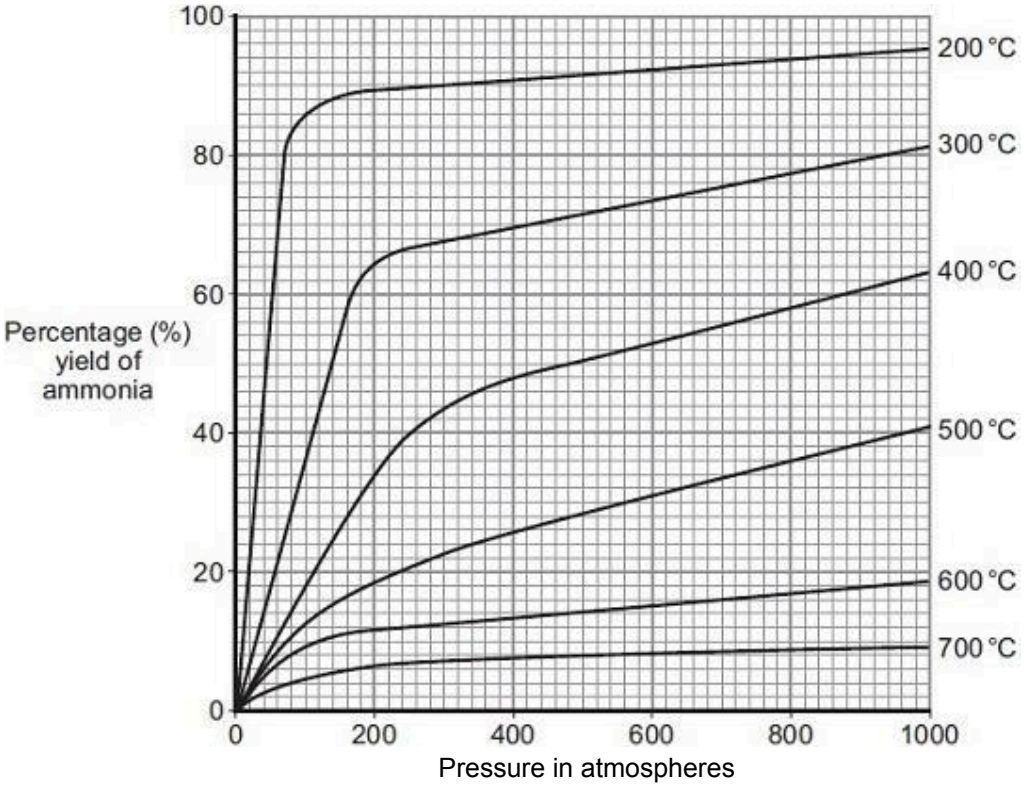
In 1909 Fritz Haber invented a process to produce ammonia from nitrogen and hydrogen.

(a) Complete and balance the chemical equation for the production of ammonia from nitrogen and hydrogen.

$$N_2 + 3\,H_2 \rightleftharpoons \_\_\_\_\_$$

(2)

(b) The figure below shows how the equilibrium yield of ammonia changes with pressure at different temperatures.



(i) Use the information in given in the figure to complete the sentence.

The temperature on the graph that gives the highest yield of ammonia is

_____ °C.

(1)

(ii) The temperature used in the Haber process for the production of ammonia is 450 °C.

Why is a temperature much lower than 450 °C **not** used for the Haber process?

_____

_____

(1)

(iii) Use the information in the figure to answer this question.

Draw a ring around the pressure that gives the highest yield of ammonia.

100 **200** **300** **400**

(1)

(iv) The pressure used in the Haber process for the production of ammonia is 200 atmospheres.

Why is a pressure lower than 200 atmospheres **not** used for the Haber process?

_____

_____

(1)

(c) Explain how ammonia is separated from unreacted nitrogen and hydrogen in the Haber process.

_____

_____

_____

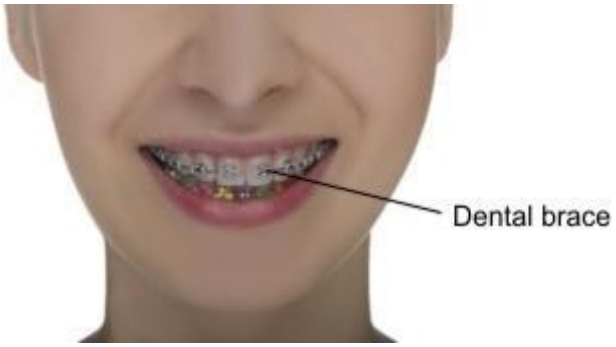
_____

(2)

(Total 8 marks)

Q10.

Dental braces are made from nitinol wires. Nitinol is a mixture of metals.



/iStock/Thinkstock © Zametalov/iStock/Thinkstock

(a) Nitinol can return to its original shape after being deformed.

Draw a ring around the correct answer to complete the sentence.

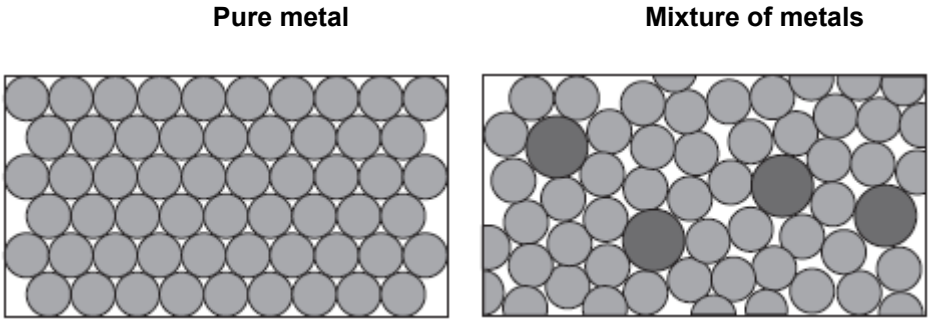
Nitinol is a shape memory

alloy.
catalyst.
polymer.

(1)

(b) **Figure 1** shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 1



The mixture of metals is harder than the pure metal.

Use **Figure 1** to explain why.

_____

_____

_____

_____

(2)

(c) Gold and stainless steel are also used for dental braces.

Suggest **two** factors to consider when choosing which metal to use for dental braces.

_____

_____

_____

_____

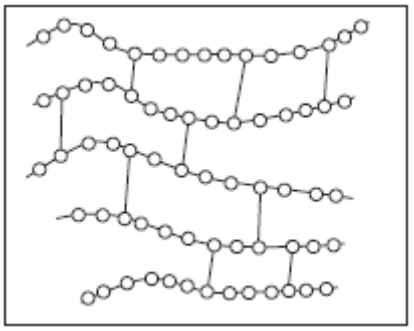
(2)

(d) A thermosetting polymer is used to hold dental braces on the teeth.

Figure 2 shows the structure of a thermosetting polymer.

Figure 2

Thermosetting polymer



How can you tell from **Figure 2** that the polymer is thermosetting?

_____

_____

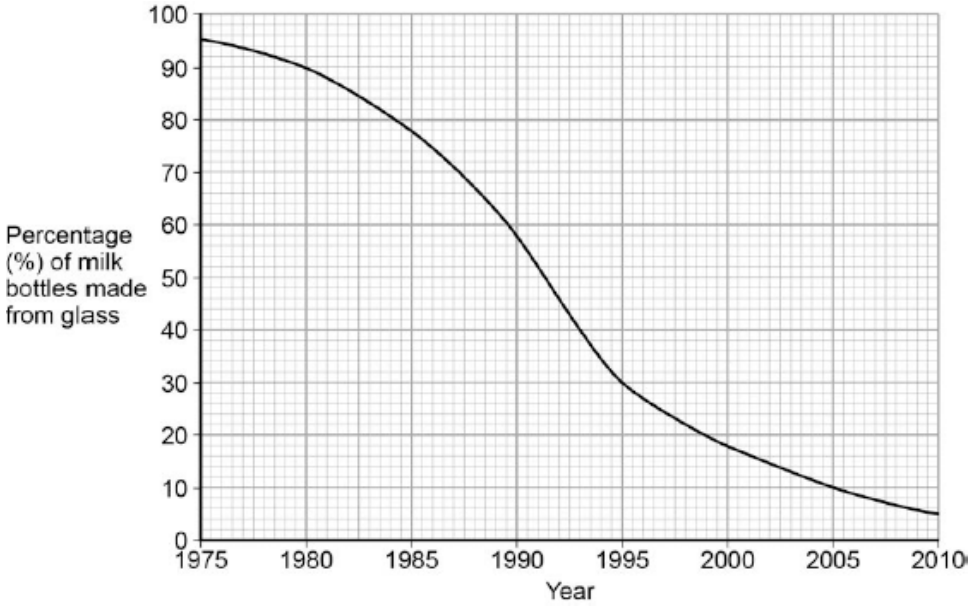
(1)

(Total 6 marks)

Q11.

Plastic and glass can be used to make milk bottles.

The figure below shows the percentage of milk bottles made from glass between 1975 and 2010.



(a) Plot the points and draw a line on the figure above to show the percentage of milk bottles made from materials **other** than glass between 1975 and 2010.

(3)

(b) The table below gives information about milk bottles.

	Glass milk bottle	Plastic milk bottle
Raw materials	Sand, limestone, salt	Crude oil
Bottle material	Soda-lime glass	HD poly(ethene)
Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.
Maximum temperature in production process	1600 °C	850 °C
Number of times bottle can be used for milk	25	1
Size(s) of bottle	0.5 dm^3	0.5 dm^3, 1 dm^3, 2 dm^3, 3 dm^3
Percentage (%) of recycled material used in new bottles	50 %	10 %

Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

Q12.

This question is about ammonia and fertilisers.

(a) Ammonia is produced by a reversible reaction.

The equation for the reaction is:

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

Complete the sentence.

The forward reaction is exothermic, so the reverse reaction

is _____

(1)

(b) Calculate the percentage by mass of nitrogen in ammonia (NH_3).
Relative atomic masses (A_r): H = 1; N = 14
You **must** show how you work out your answer.

_____

_____

_____

_____

_____

_____

Percentage by mass of nitrogen = _____ %

(3)

(c) A neutral solution can be produced when ammonia reacts with an acid.

(i) Give the pH of a neutral solution.

pH _____

(1)

(ii) Which of these ionic equations shows a neutralisation reaction?

Tick (✔) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

(1)

(iii) Name the salt produced when ammonia reacts with hydrochloric acid.

_____

(1)

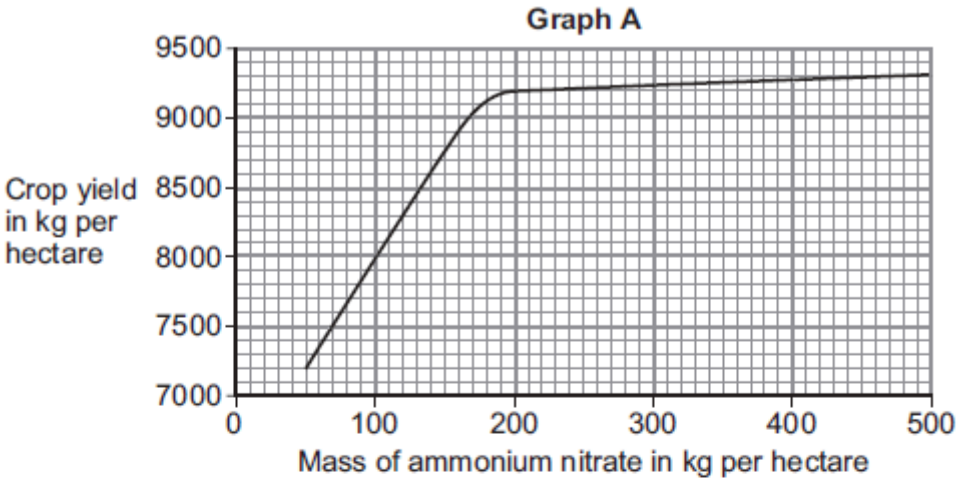
(d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

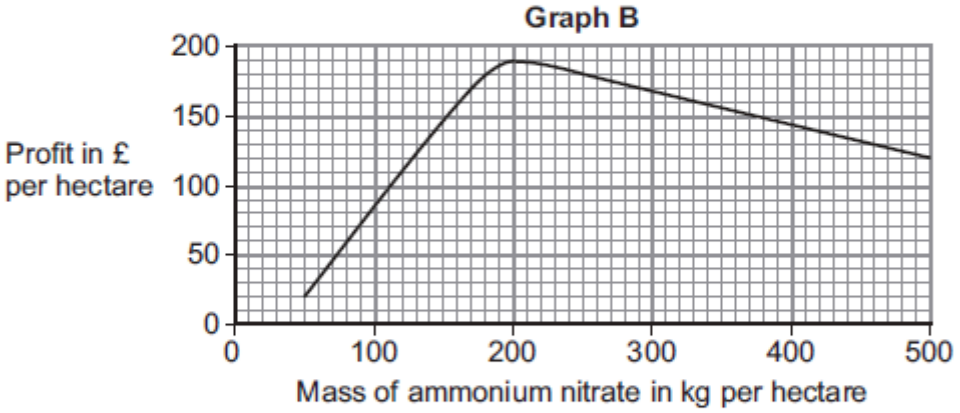
Farmers use ammonium nitrate as a fertiliser for crops.

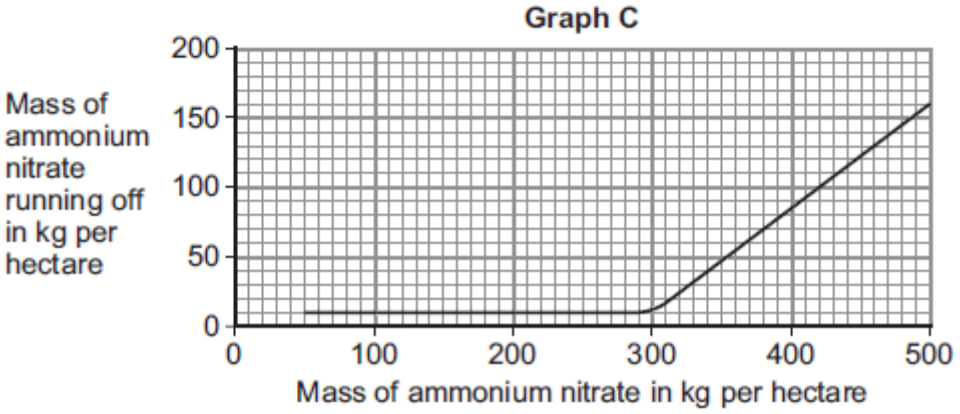
Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

The graphs **A**, **B** and **C** below show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.







Suggest how much ammonium nitrate farmers should use per hectare.

Give reasons for your answer.

Use information from graphs **A**, **B** and **C**.

_____

_____

(6)

(Total 13 marks)

Q13.

This question is about metals and alloys.

(a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

(4)

(b) Describe how the structure of an alloy is different from the structure of a pure metal.

_____

_____

_____

_____

(2)

(c) Alloys are used to make dental braces and coins.

(i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

_____

_____

(1)

(ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

_____

_____

(1)

(iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

Aluminium is manufactured by the electrolysis of a molten mixture of cryolite

and _____ .

(1)

(iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

_____

_____

(1)

(d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

_____

_____

_____

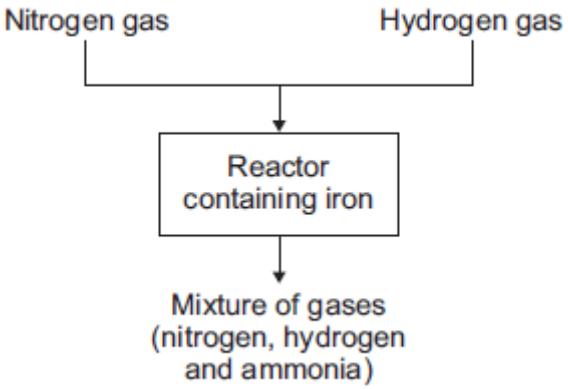
(1)

(Total 11 marks)

Q14.

The graph in **Figure 1** shows a flow diagram for the Haber process.

Figure 1



(a) (i) Hydrogen gas is obtained from methane.
Name **one** source of methane.

_____

(1)

(ii) Air is the source used to produce nitrogen for the Haber process.
Suggest why air must **not** get into the reactor.

_____

_____

_____

(2)

(iii) Describe what happens to the mixture of gases from the reactor.

_____

_____

_____

_____

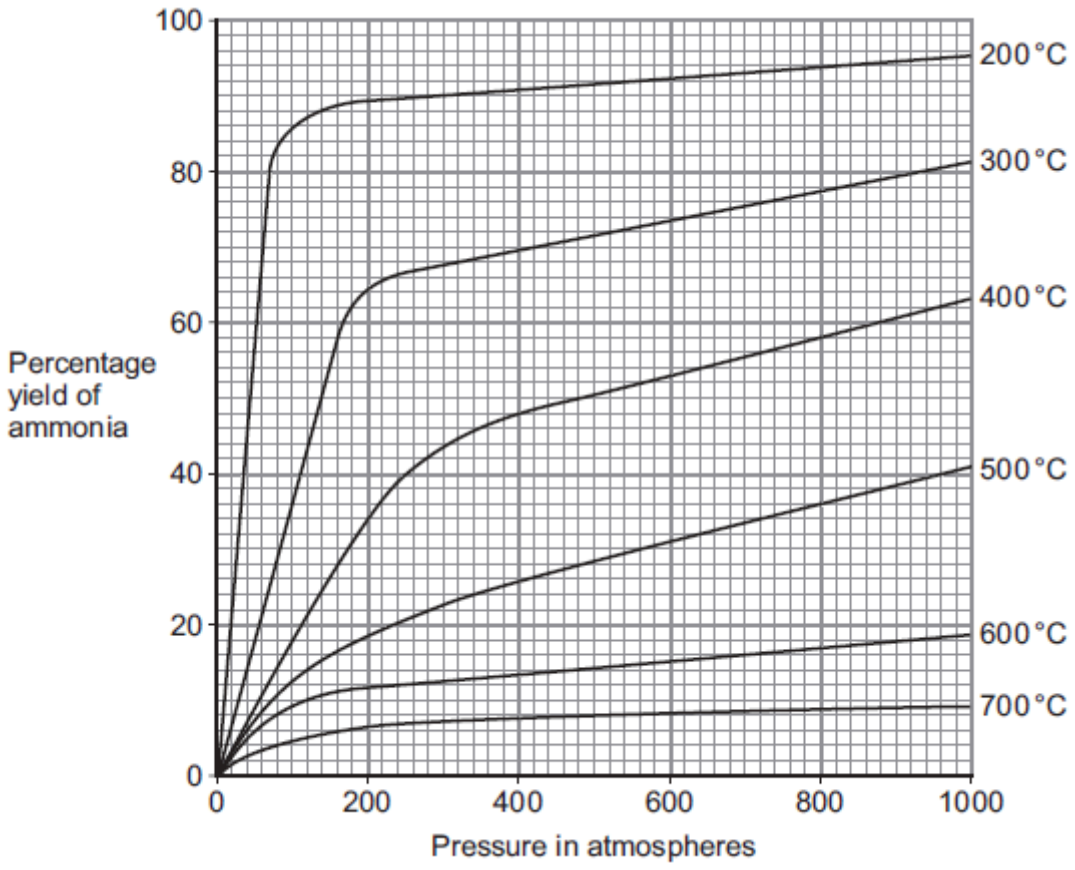
_____

_____

(3)

(b) The graph in **Figure 2** shows the percentage yield of ammonia using different conditions.

Figure 2



(i) Use **Figure 2** to suggest the conditions that produce the greatest yield of ammonia.

_____

_____

(1)

(ii) Use **Figure 2** to suggest and explain why the conditions used to produce ammonia in the Haber process are a temperature of 450 °C and a pressure of 200 atmospheres.

(5)

(Total 12 marks)

Q1.

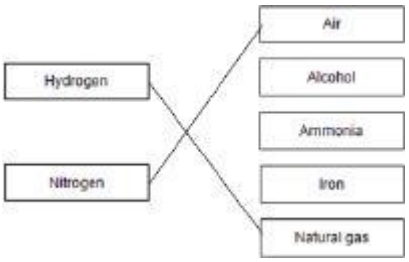
(a) 4

1

(b) reversible (reaction)

1

(c)



1
1

(d) −40 °C

1

(e) recycled to the reactor

1

(f) ionic

1

(g) nitrogen

1

phosphorus

1

(h) 0.24 × 50 × 5

allow £87.50

1

= £60

1

*an answer of £60 scores **2** marks*

(i) may need to use nitrogen, phosphorus and potassium

allow neither fertiliser has all the elements / nutrients needed.

[12]

Q2.

(a) 50

1

(b) 5%

1

(c) any **two** from:

- cost (9 carat is cheaper)

- pure gold is soft
  or
  24 carat gold is soft
  or
  9 carat gold is harder
  allow 9 carat gold is stronger
  allow gold is an alloy in 9 carat gold
- can change the colour

2

[4]

Q3.

(a) (i) many ethene / molecules / monomers
accept double bonds open / break
accept addition polymerisation

1

join to form a long hydrocarbon / chain / large molecule
ignore references to ethane
*correct equation gains **2** marks*

1

(ii) (can be deformed but) return to their original shape (when heated or cooled)
ignore 'it remembers its shape'

1

(iii) cross links / extra bonds in PEX
it = PEX throughout
accept inter-molecular bonds
ignore inter-molecular forces

1

molecules / chains in PEX are held in position
accept rigid structure

1

molecules / chains in PEX unable to slide past each other / move

1

(b) any **four** from:
ignore costs / sustainability / non-renewable

- less (hydrocarbon) fuels used
  allow less energy
- less / no electrical energy used
  allow no electrolysis
- reduce carbon / carbon dioxide emissions
  allow less global warming
- reduce / no pollution by sulfur dioxide / acid rain
  allow less / no transportation
- continuous process

- conserve copper which is running out or only low-grade ores available
  allow less waste
- reduce the amount of solid waste rock that needs to be disposed
  allow less mining
- reduce the need to dig large holes (to extract copper ores)

4

[10]

Q4.

(a) (i) hydrogen
must be name

1

(ii) a line of four or more ethene molecules joined to the original two with single bonds
*at least two other ethene molecules joined to the original two in a chain gains **1** mark*

2

(b) (i) any **two** from:

- non-biodegradable
  accept remains a long time
- landfill sites are filling up / limited
  accept land / space used up
- waste of a resource / could be recycled / reused
  ignore references to tablets / animals

2

(ii) any **one** from:

- (two) different polymers / plastics / materials
- need to be separated
- limited collection points / many need to be collected
- tablets may still be present

1

[6]

Q5.

(a) 1×10^{-2} g

1

(b) $\frac{0.46}{8.45} \times 100$

1

(test tube 1) 5.44 %
and
(test tube 2) 0.854 %

1

4.586

1

4.59

1

allow ecf answer correctly calculated to 3 significant figures

*allow 4.59 with no working for **4** marks*

*allow 4.586 with no working for **3** marks*

(c) **Level 3 (5–6 marks):**
Detailed and coherent conclusions based on the evidence together with an evaluation are given in a response that is coherent and well-structured. A range of relevant points is made demonstrating a broad understanding of the key scientific ideas.

Level 2 (3–4 marks):
An attempt to relate relevant points and draw conclusions or to make an evaluation. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Simple descriptive statements are made. The logic may be unclear and any conclusions, if present, may not be consistent with the reasoning.

0 marks:
No relevant content.

Indicative content

Simple statements

- nail rusted in test tubes 1 and 5
- test tubes 1 and 4 contained air / oxygen and water
- nail did not rust in test tubes 2, 3 and 4
- test tube 2 no water present
- test tube 3 no air / oxygen present
- test tube 4 paint stopped rusting
- test tube 6 scratched galvanised iron did not rust
- test tube 6 galvanising stopped rusting

Conclusions

- both water and oxygen are required for rusting
- coatings that prevent water and oxygen reaching the metal prevent rusting
- when paint is scratched, iron comes into contact with water and oxygen and the iron rusts
- in test tube 5 less iron exposed so less rusting than in test tube 1
- galvanising is better at resisting rusting than paint when scratched
- zinc is more reactive than iron, so when galvanised metal is scratched, zinc reacts with water and oxygen first / sacrificially

Evaluation

- oil and paint are effective at preventing rusting when the coating is intact
  galvanising is the most effective coating because it prevents rusting even when scratched.

6

(d) iron + oxygen + water

*all three needed for **2** marks*

*2 correct = **1** mark*

ignore air

2

[13]

Q6.

(a) 79

1

79

1

(b) hundred

1

(c) (i) electron(s)

1

(ii) three

1

(d) changes rate of reaction

accept lowers activation energy

or

speeds up / slows down reaction

accept reduces costs

1

(e) (i) melt

1

(ii) crosslinking

allow answers on diagram

or

(covalent) bonds between polymers / chains

allow bonds between layers
*do **not** allow intermolecular*

1

[8]

Q7.

(a) (i) 2.5(kg)

ignore units

1

(ii) 40% (cement) **and** Test 3

ignore units

1

because it is anomalous or because it is much lower than the other two readings

accept value not used to calculate mean

ignore outlier

1

(iii) as the percentage of cement increases the mass needed to break the sleeper increases

allow 'strength' for 'mass needed'
allow correct relationship using percentage of sand

1

(iv) volume/percentage / amount of water
accept temperature

1

(b) any **two** from:

- availability (of the raw materials)
- cost of the raw materials
- purity (of the raw materials)

2

[7]

Q8.

(a) (i) brown

1

(ii) oxygen + iron + water ⟶ hydrated iron oxide / rust
allow correct symbol equation
ignore oxidation numbers for product

1

(b) (i) 32.3

1

(ii) 7.6
ecf from (b)(i)

1

(iii) do not know start volume of air

1

because the burette not graduated to the end
allow iron wool takes up some of the space
*if no other marks awarded accept all iron may have rusted (**1**) **or** still some oxygen left / not all used up (**1**)*

1

(c) (i) gains oxygen and water **or** oxygen and water are added
allow reacts with or gains oxygen
allow reacts with or gains water
allow reacts with or gains elements which add to mass
ignore iron oxide forms

1

(ii) as temperature increases (from 10 °C to 42 °C or to 50 °C) the increase in mass of nail increases
accept positive correlation
accept mass increases

1

rate of increase gets faster as temperature goes up

accept exponential
ignore non linear

1

no further increase at temperatures over 42 °C

accept no further increase at high temperatures
*exponential increase scores **2** marks*

1

(iii) use a (bigger) flask **or** let air into the tube **or** leave for less time **or**

ignore more water

1

to make sure sufficient oxygen / air **or** not all oxygen used up

accept converse
*if no other marks awarded allow change in surface area for rusting **or** change in number of nails for **1** mark*

1

[12]

Q9.

(a) $2NH_3$

*allow NH_3 with incorrect or missing balancing for **1** mark*
allow multiples

2

(b) (i) 200

1

(ii) rate of reaction (too) slow

allow converse
ignore references to yield / cost

1

(iii) 400

1

(iv) lower yield

allow converse
accept shifts equilibrium to left
allow favours the backward reaction
allow favours side with more (gaseous) molecules
allow lower rate

1

(c) (gases) cooled

it = ammonia

1

ammonia liquefied

accept ammonia condensed
*accept ammonia cooled below boiling point for **2** marks*

1

[8]

Q10.

(a) alloy

1

(b) in mixture:

different sized / bigger atoms

1

so there are no layers / rows / lines (to slide)

accept converse

1

(c) any **two** from:

ignore references to bend and mould

- cost
- toxicity
- strength
- *appearance of brace*
- *unreactive **or** resistant to corrosion / saliva*

allow rusting as alternative to corrosion

2

(d) crosslinks

allow lines / bonds between the rows / chains

1

[6]

Q11.

(a) all points correct

±1 small square

allow 1 mark for 6 or 7 plots

2

Year	Percentage (%) of bottles made from other materials
1975	5
1980	10
1985	22
1990	42
1995	70
2000	72
2005	90
2010	95

1

(b) **Level 3 (5–6 marks):**
A detailed and coherent argument is provided which considers a range of issues and comes to a conclusion consistent with the reasoning.

Level 2 (3–4 marks):
An attempt to describe the advantages and disadvantages of the production and uses is made, which comes to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):

Simple statements made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

0 marks:
No relevant content.

Indicative content

- glass – 2 stages in production of soda-lime glass
- glass – second stage, heating sand, limestone and sodium carbonate
- HDPE – 3 stages in production
- HDPE – second stage, cracking of naphtha to obtain ethene
- HDPE – third stage, polymerisation of ethene
- fewer stages in glass production, may be quicker
- higher temperature in glass manufacture, therefore maybe higher energy requirement
- glass bottle can be reused
- consideration of collection / cleaning costs to reuse glass bottles
- other glass products can be made from recycled glass
- plastic has greater range of sizes
- both produced from limited raw materials
- higher percentage recycled materials in glass conserves raw materials

This indicative content is not exhaustive, other creditworthy responses should be awarded marks as appropriate.

6

[9]

Q12.

(a) endothermic

1

(b) 82 (%)

*correct answer with working gains **3** marks*

*if 17 or 34 not shown in working **max 2** marks*

accept 82.4

accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf

if no answer or incorrect answer, then

*(M_r =) 17 gains **1** mark **or***

*14/17 gains **2** marks*

OR

*($2M_r$ =) 34 gains **1** mark **or***

*28/34 gains **2** marks*

OR

*14/their M_r shown gains **1** mark **or***

*correct calculation of 14/their M_r gains **2** marks*

3

(c) (i) 7 / seven

1

(ii) $H^+ + OH^- \rightarrow H_2O$

1

(iii) ammonium chloride

allow NH_4Cl

1

ignore an incorrect formula

(d) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise.

Level 2 (3 – 4 marks):
Suggestion with reasons referring to more than one graph.

Level 1 (1 – 2 marks):
Suggestion with a reference to a graph.

0 marks:
No relevant content.

Examples of chemistry points made in response:
A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha).
Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

Yield:
- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

Profit:
- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

Run off:
- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

Examples of linking of ideas:
- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

Examples of compromise:
- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

6

[13]

Q13.

(a) giant structure / lattice / layers / close packed

first 3 marks can be obtained from a suitably labelled diagram
incorrect structure or bonding or particle = max 3

1

made up of atoms / <u>positive</u> ions

1

with delocalized / free electrons

1

so electrons can move / flow through the metal

accept so electrons can carry charge through the metal

accept so electrons can form a current

1

(b) an alloy (is a metal which) has different types / sizes of atoms

accept converse for pure metal throughout

both marks can be obtained from suitable diagrams

allow made of different metals

allow mixture of metals / atoms / elements

ignore particles

ignore properties

*do **not** accept compound*

1

alloy has distorted layers

allow layers are unable to slide

1

(c) (i) can return to its original shape

accept shape memory alloy

accept smart alloy

ignore other properties

1

(ii) (pure copper is too) soft

accept converse

accept malleable or bends

accept copper is running out

ignore references to strength and weakness

1

(iii) aluminium oxide

accept alumina

accept Al_2O_3

ignore bauxite / aluminium ore

1

(iv) any **one** from:

- different conditions
- different catalyst
- different pressure

allow different concentration

- different temperature.

*do **not** accept different monomers*

1

(d) any **two** from:

- accurate
- sensitive
- rapid
- small sample.

both needed for 1 mark

1

[11]

Q14.

(a) (i) natural gas

allow fossil fuels / biogas generator

1

(ii) air contains oxygen

1

this would react with / oxidise the hydrogen

allow this would react with / oxidise the iron

ignore nitrogen

1

(iii) cooled

1

ammonia condenses / liquefies (so can be separated)

1

nitrogen and hydrogen (remain as gases and) are returned to the reactor

allow recycled

1

(b) (i) 200 °C **and** 1000 atmospheres

1

(ii) the reaction is reversible

allow stated as equilibrium or forward / backward reaction anywhere in answer

1

forward reaction is exothermic so increased temperature lowers the yield of ammonia

allow converse

1

a lower temperature would decrease rate of reaction

allow converse

1

a higher pressure would increase the yield of ammonia because the forward reaction produces the least number of (gaseous) molecules / moles

allow converse

1

higher pressures would involve high cost / energy

1

ignore risk / explosion

[12]