AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.3.2

Alloys as useful materials

Past-paper questions

Tier	**Foundation**
Question groups	**48**
Available paper years	**2007–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.10.3.2 Alloys as useful materials

Question 01

June 2007 | CHY1A | Original Q6 | Legacy

QUESTION SIX

This question is about iron and steel.

Match properties, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A hard

B resistant to corrosion

C easily shaped

D brittle

Iron from the blast furnace has few uses because it is . . . **1** . . . .

A low carbon steel is used to make wire because it is . . . **2** . . . .

A high carbon steel is used to make hammers and chisels because it is . . . **3** . . . .

A stainless steel is used to make cutlery because it is . . . **4** . . . .

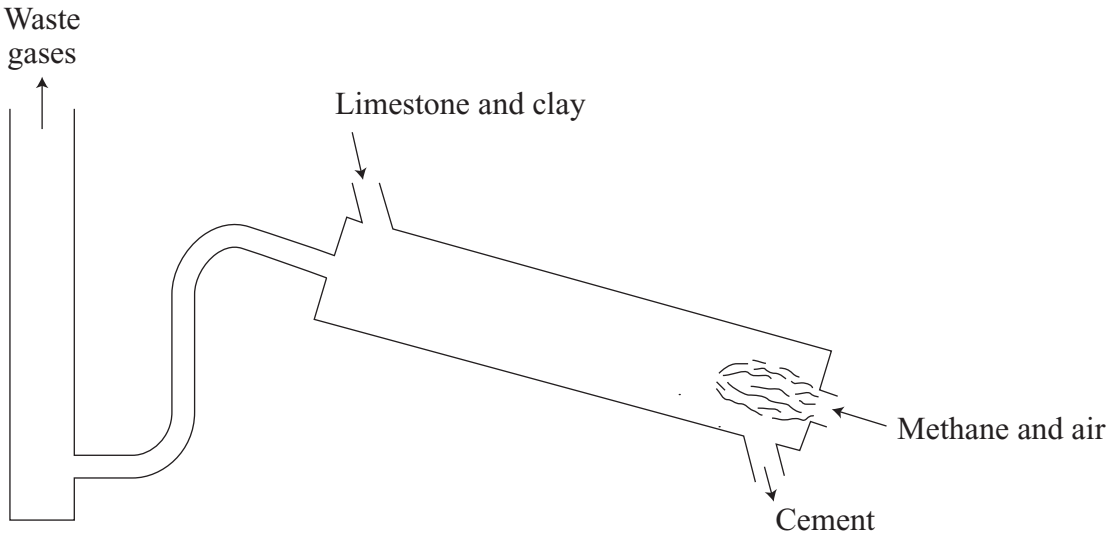
4.10.3.2 Alloys as useful materials

Question 02

June 2007 | CHY1F | Original Q6 | Legacy

6 Limestone contains the compound calcium carbonate, $CaCO_3$.

(a) Limestone is used to make cement in a rotary kiln.



Use the information in the diagram to name the **two** main waste gases from this rotary kiln.

1 .....

2 .....

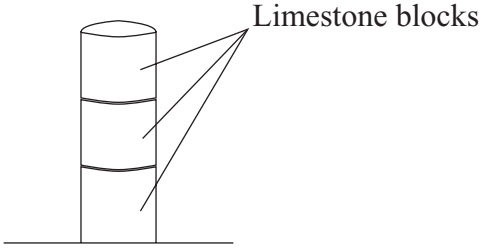
(2 marks)

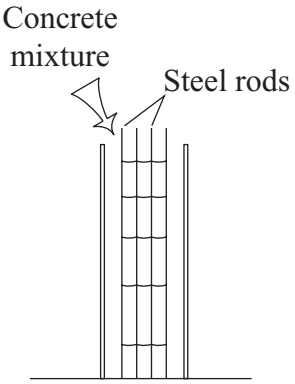
4.10.3.2 Alloys as useful materials

Question 02 · continued

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(b) Columns used as supports for buildings can be made from materials such as limestone blocks or concrete.





Concrete is a mixture of
cement, sand, small stones and water

From the diagrams, name which you think is the better material for making a column.

.....

Give **three** advantages for your choice of material.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

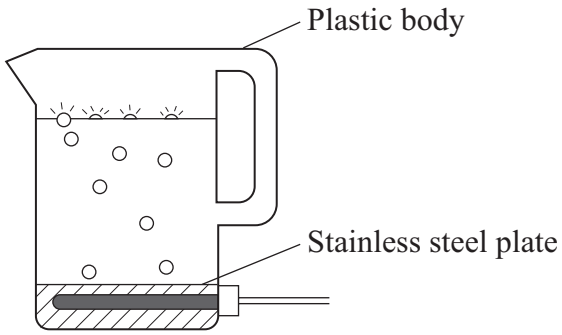
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4.10.3.2 Alloys as useful materials

Question 03

January 2008 | CHY1F | Original Q4 | Legacy

4 Plastics are used to make many everyday items, such as the body of the kettle.



(a) Complete the sentences by drawing a ring around the correct words.

(i) The plastic is made from many small molecules called [catalysts / monomers / polymers] .

(1 mark)

(ii) Propene is produced by cracking some of the fractions that are separated from [crude oil / limestone / metal ores] .

(1 mark)

4.10.3.2 Alloys as useful materials

Question 03 · continued

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(b) After a few years the kettle no longer worked.

- Some parts of the kettle are made of plastic.
- Some parts of the kettle are made of stainless steel.
- The owner of the kettle disposed of it in a landfill site.

Consider these statements.

Suggest **three** reasons why the kettle should **not** be disposed of in a landfill site.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

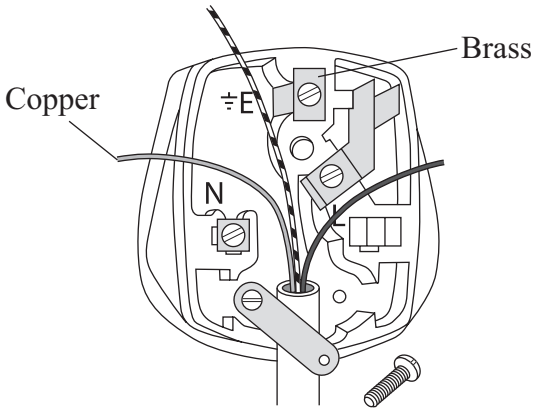
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4.10.3.2 Alloys as useful materials

Question 04

January 2008 | CHY1F | Original Q6 | Legacy

6 Copper metal is used for electric wires.
An alloy of copper, called brass, is used for pins and terminals of electric plugs.



(a) Copper metal is relatively soft and flexible.

Give another reason why copper is used for electric wires.

.....

.....

(1 mark)

(b) Brass is an *alloy*.

What is an *alloy*?

.....

.....

(1 mark)

Question 6 continues on the next page

4.10.3.2 Alloys as useful materials

Question 04 · continued

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(c) Open-cast mining of copper ore makes a very large hole.



Source: Photograph © Melvyn P. Lawes; *Papilio/CORBIS*

(i) Suggest **one** environmental problem that is caused by open-cast mining of copper ore.

.....

.....

(1 mark)

(ii) Some copper ores contain copper sulfide, CuS.
Copper sulfide is heated in air to produce copper and sulfur dioxide.

$$CuS + O_2 \rightarrow Cu + SO_2$$

Suggest **one** environmental problem caused by heating copper sulfide in air.

.....

.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 04 · continued

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(d) The amount of copper-rich ores is estimated to last only a few more years.
New houses need several kilometres of copper wire.

(i) Explain why the need to use so much copper will cause a problem in the future.

.....

.....

(1 mark)

(ii) Suggest **two** ways in which society could overcome this problem.

1 .....

.....

2 .....

.....

(2 marks)

7

4.10.3.2 Alloys as useful materials

Question 05

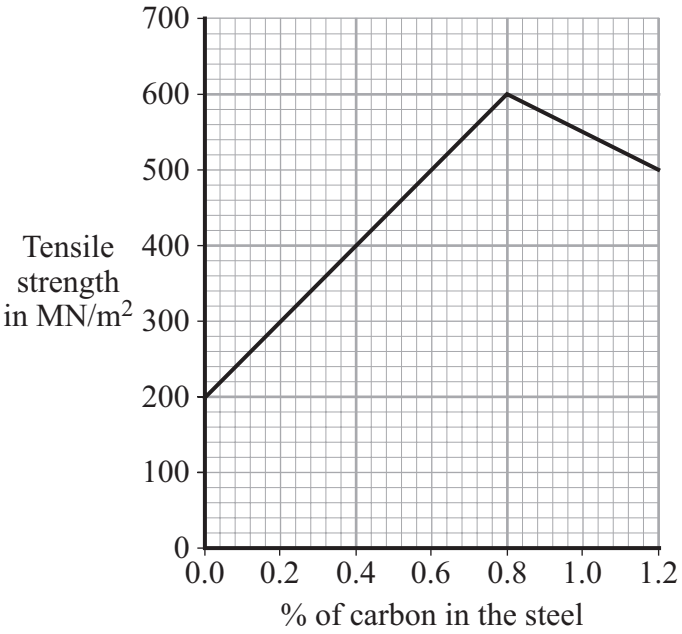
March 2008 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Materials with a high tensile strength do **not** break easily when pulled.

To measure the tensile strength of steel, a sample is pulled with a larger and larger force until it breaks.

The graph shows how the tensile strength of different steels depends on the percentage (%) of carbon the steels contain.



7A One type of steel has a tensile strength of 400 MN/m^2.

How much carbon does it contain?

1 0.3 %

2 0.4 %

3 0.5 %

4 4.0 %

Question 05 · continued

7B The steel with the highest tensile strength is one with . . .

1 0.6% carbon.

2 0.8% carbon.

3 1.2% carbon.

4 8.0% carbon.

7C From the evidence on the graph, what is the best way to describe how carbon affects the tensile strength of steel?

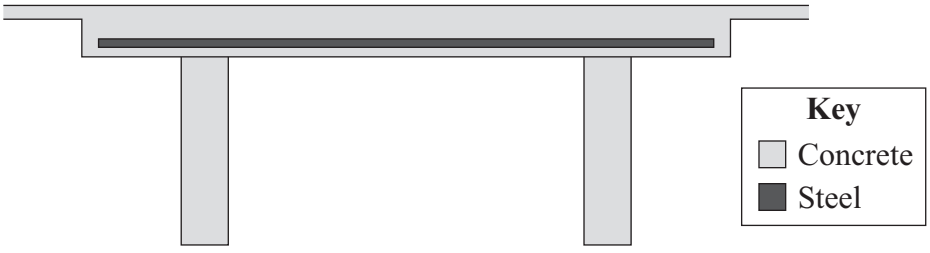
1 As the carbon content decreases, the tensile strength increases.

2 As the carbon content increases, the tensile strength decreases.

3 As the carbon content increases, the tensile strength increases then decreases.

4 The tensile strength increases when the carbon content is greater than 0.8%.

7D The diagram shows one type of bridge design.



The tensile strength of concrete is very low compared with the tensile strength of steel.

Some other comparisons of concrete and steel are shown below.

	Compressive strength (MN/m^2)	Density (kg/m^3)	Cost
Concrete	30	2300	Low
Steel	250	7700	Medium

Two reasons why the bridge is **not** made only of steel are that . . .

1 steel has a high density and is expensive.

2 steel has a high compressive strength and a high density.

3 steel has a high tensile strength and a high compressive strength.

4 steel has a high tensile strength and a high density.

4.10.3.2 Alloys as useful materials

Question 06

June 2008 | CHY1F | Original Q6 | Legacy

6 Metals and their alloys have many uses.

6 (a) Dentists use a smart alloy to make braces that gently push teeth into the right position.

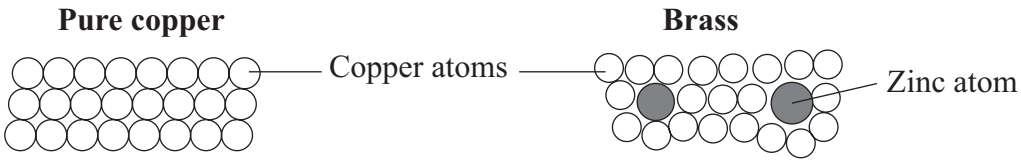
What is meant by a *smart alloy*?

.....

.....

(1 mark)

6 (b) Pure copper is made up of layers of copper atoms. Brass is an *alloy* of copper and zinc.



Why are the physical properties of brass different from the physical properties of pure copper?

.....

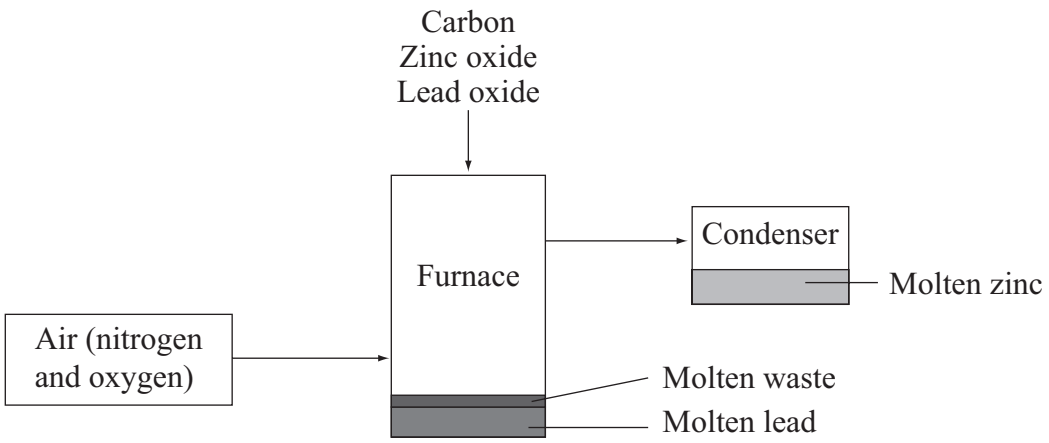
.....

.....

.....

(2 marks)

6 (c) Nearly all zinc is obtained from ores that also contain lead. The metals zinc and lead can be extracted by reducing their oxides using carbon.



4.10.3.2 Alloys as useful materials

Question 06 · continued

for mark

6 (c) (i) Choose **one** element from the box below to complete the sentence about the reduction of zinc oxide.

lead	**nitrogen**	**oxygen**

Zinc oxide is reduced by carbon, which takes away..... to leave zinc metal.

(1 mark)

6 (c) (ii) The melting points and boiling points of lead and zinc are given in the table.

Metal	**Lead**	**Zinc**
Melting point in °C	328	420
Boiling point in °C	1740	907

The furnace operates at a temperature of 1200 °C.

Suggest how the lead metal and zinc metal are separated in the furnace.

.....

.....

.....

.....

(2 marks)

6

4.10.3.2 Alloys as useful materials

Question 07

November 2008 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

This question is about copper and its alloys.

Match descriptions, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A a mixture

B expensive to extract from its ore

C a good conductor

D hard-wearing

It is worth recycling copper because it is . . . **1** . . . .

Copper is difficult to separate from an alloy because the alloy is . . . **2** . . . .

Bronze (a copper alloy), has been used for hundreds of years for making coins because it is . . . **3** . . . .

Copper is used for electrical wiring because it is . . . **4** . . . .

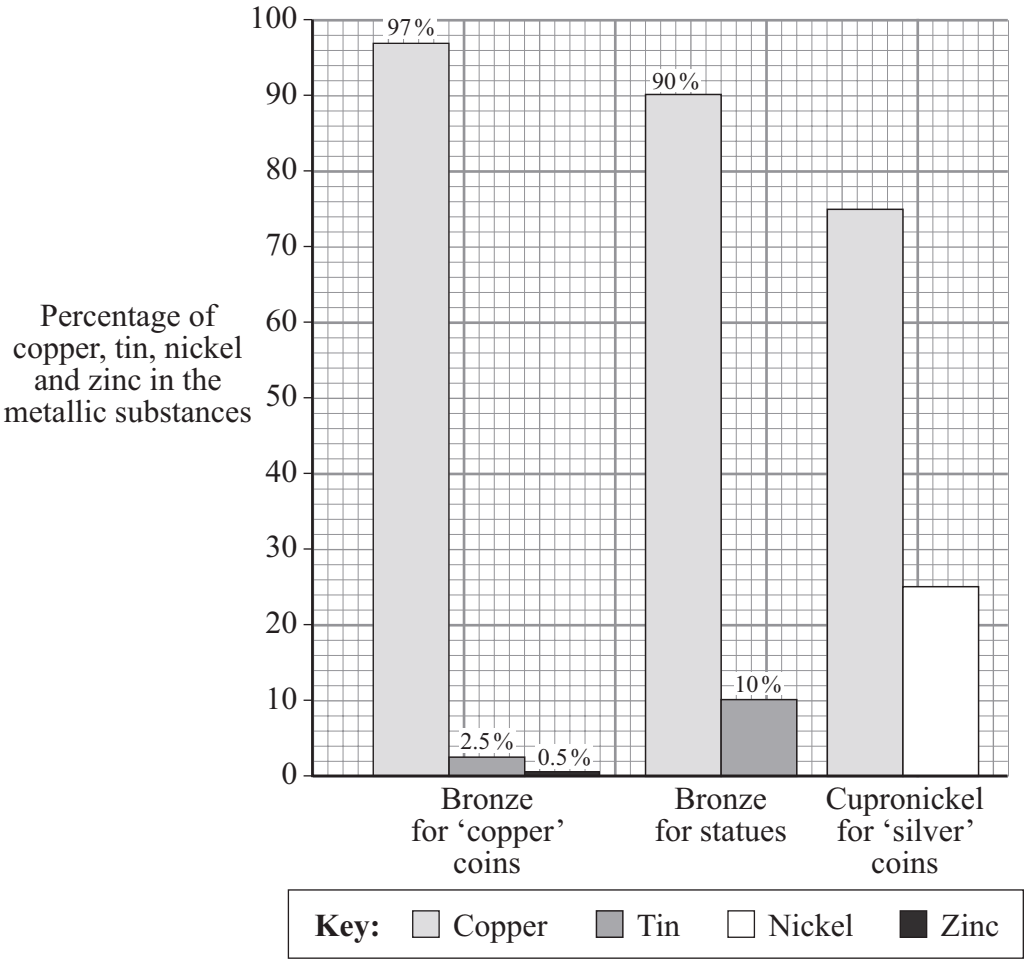
4.10.3.2 Alloys as useful materials

Question 08

November 2008 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

The bar chart shows the composition of three metallic substances.



6A Bronze and cupronickel are examples of . . .

1 compounds.

2 alloys.

3 elements.

4 ores.

4.10.3.2 Alloys as useful materials

Question 08 · continued

6B ‘Silver’ coins are made from cupronickel.

What percentage of nickel do these coins contain?

1 10 %

2 15 %

3 25 %

4 75 %

6C Compared with bronze for ‘copper’ coins, the bronze used for statues contains . . .

1 a higher ratio of copper to tin.

2 four times as much tin.

3 less tin per 100 g of mixture.

4 more metal elements.

6D The most likely reason for recycling bronze is . . .

1 to conserve ore deposits.

2 to reclaim zinc.

3 that bronze statues are no longer made.

4 that the price of bronze has fallen.

4.10.3.2 Alloys as useful materials

Question 09

March 2009 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

Solder is an alloy of lead and tin. The table shows how the percentage of tin affects some of the properties of solder.

Percentage of tin	Tensile strength in MPa	Melting point in °C	Density in g per cm^3
0	12	347	11.35
10	30	297	10.50
20	33	257	10.40
30	34	217	9.66
40	37	187	9.28
50	41	147	8.90
60	52	153	8.52
70	54	167	8.17

9A What is the density of lead in g per cm^3?

1 8.17

2 8.90

3 11.35

4 12.00

9B Increasing the percentage of tin in solder . . .

1 decreases the tensile strength of the solder.

2 decreases the density of the solder.

3 increases the flexibility of the solder.

4 increases the melting point of the solder.

4.10.3.2 Alloys as useful materials

Question 09 · continued

9C How could the lowest melting point of solder be found accurately?

1 by using a more accurate type of thermometer

2 by repeating the measurements between 30 % and 50 % tin

3 by increasing the number of measurements between 40 % and 60 % tin

4 by increasing the number of measurements between 50 % and 70 % tin

9D How might the relationship between the percentage of tin in solder and the melting point of solder best be described?

1 The relationship is directly proportional.

2 There is no relationship.

3 As the percentage of tin increases, the melting point decreases steadily.

4 As the percentage of tin increases, the melting point decreases, and then starts to rise.

END OF TEST

4.10.3.2 Alloys as useful materials

Question 10

November 2009 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about metals.

Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A metal ore

B reactive metal

C transition metal

D metal alloy

1	a substance that contains enough metal to make it worth extracting
2	a mixture of metals
3	a metal that is found in the central block of the periodic table
4	a metal that cannot be extracted by reduction using carbon

4.10.3.2 Alloys as useful materials

Question 11

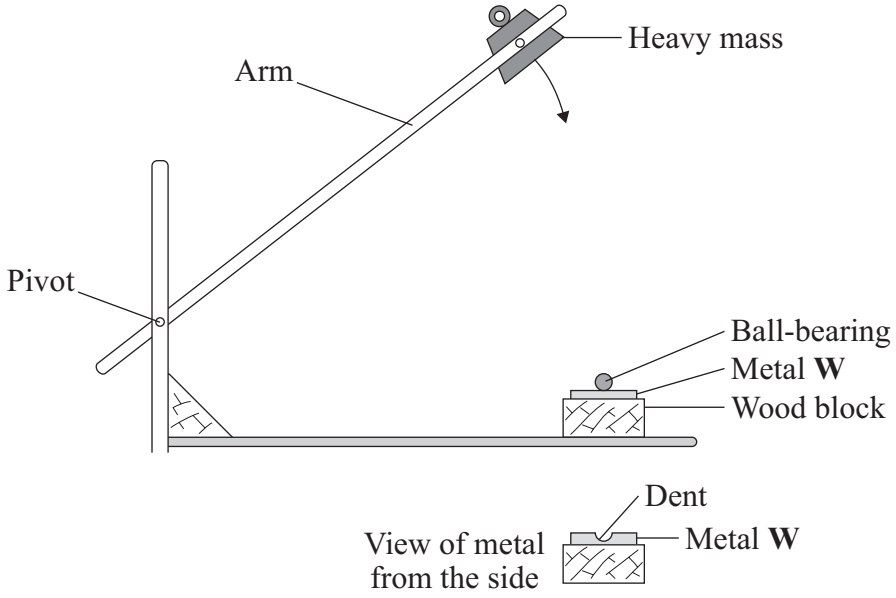
November 2009 | CHY1AP | Original Q6 | Legacy

QUESTION SIX

A student was asked to investigate the hardness of four metals, **W**, **X**, **Y** and **Z**. He used the apparatus shown in the diagram.

The student allowed the heavy mass to drop onto the ball-bearing resting on metal **W**. This made a dent in metal **W**. He measured the diameter of the dent.

The student repeated the experiment using metals **X**, **Y** and **Z**. He attempted to drop the heavy mass from the same height each time.



The results of the experiment are shown in the table.

Metal	Diameter of dent in mm
W	3.5
X	1.0
Y	2.5
Z	0.0

4.10.3.2 Alloys as useful materials

Question 11 · continued

6A The order of hardness of the metals, starting with the softest, is . . .

1 **W**, **X**, **Y**, **Z**.

2 **W**, **Y**, **X**, **Z**.

3 **Y**, **X**, **W**, **Z**.

4 **Z**, **X**, **Y**, **W**.

6B The student could make his results more precise by . . .

1 dropping a smaller mass onto the ball-bearing.

2 dropping the mass from different heights.

3 repeating the test on each metal and calculating the average diameter of the dent.

4 using an instrument with smaller divisions to measure the diameters of the dents.

6C Metal **W** is pure copper.

If a copper alloy was used instead, the diameter of the dent would be . . .

1 the same.

2 smaller.

3 larger.

4 deeper.

6D The student was asked to suggest some improvements to his experimental procedure.

Which of the following suggestions would be most likely to improve his results?

1 measure the time for the mass to fall from the point of release onto the ball-bearing

2 use a different ball-bearing for every test

3 use a screen around the apparatus to reduce the effects of draughts

4 use a ruler to make sure that the mass is always dropped from the same height

4.10.3.2 Alloys as useful materials

Question 12

November 2009 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

Duralumin is an alloy which contains copper and magnesium mixed with aluminium.

Aluminium is a low density metal but duralumin is used more often in making aeroplanes.

9A Aluminium, copper and magnesium are extracted from their naturally occurring compounds.

The method used for the extraction depends on . . .

1 the density of the metal.

2 the abundance of the metal compound in the Earth's crust.

3 the melting point of the metal compound.

4 the reactivity of the metal.

9B Copper can be extracted by strongly heating a mixture of the copper compound and carbon.

In this reaction, the copper compound is . . .

1 oxidised.

2 electrolysed.

3 reduced.

4 distilled.

9C Aluminium and magnesium are extracted by electrolysis.

One reason why this method is expensive is that . . .

1 the metals are resistant to corrosion.

2 the process requires a large amount of energy.

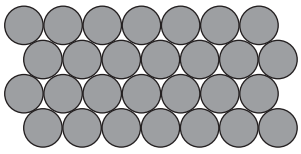
3 the metals are less reactive than carbon.

4 the metal ores are very abundant.

4.10.3.2 Alloys as useful materials

Question 12 · continued

9D The diagram shows the arrangement of the atoms in pure aluminium.



Which row in the table correctly shows how the structure and properties are different in duralumin?

	Structure	Properties
1	The layers of atoms are distorted.	The alloy is harder.
2	The copper atoms attach strongly to the aluminium atoms.	The alloy is softer.
3	The layers of atoms are distorted.	The alloy is softer.
4	The magnesium atoms attach strongly to the aluminium atoms.	The alloy is harder.

END OF TEST

4.10.3.2 Alloys as useful materials

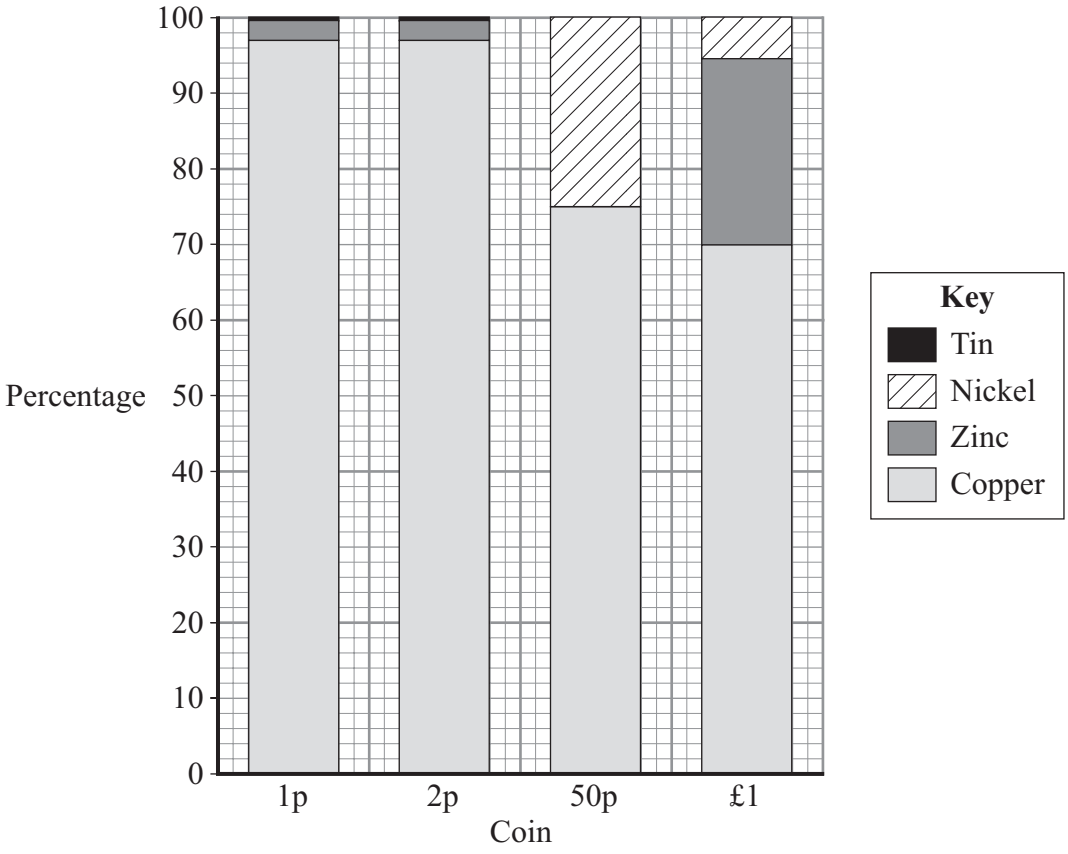
Question 13

January 2010 | CHY1F | Original Q1 | Legacy

1 This is the headline from a newspaper:

'Why is a 2p coin worth 3.3p?'

1 (a) The bar chart shows the percentages of metals in UK coins in 1991.



Use the bar chart to answer these questions.

1 (a) (i) Which metal is in all of these coins?

.....

(1 mark)

1 (a) (ii) Which coin does **not** contain zinc?

.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 13 · continued

for mark

1 (a) (iii) What is the percentage of nickel in a 50p coin?

Percentage = ... %

(1 mark)

1 (a) (iv) Draw a ring around the correct metal to complete the sentence.

Pure copper is too soft to be used for 1p and 2p coins.

Copper is mixed with zinc and | nickel | tin | iron | for 1p and 2p coins.

(1 mark)

1 (b) The value of the metal in 2p coins which were made in 1991 is now 3.3p.

1 (b) (i) Suggest why a 2p coin made in 1991 is worth 3.3p.

.....

.....

.....

(1 mark)

1 (b) (ii) Suggest why copper-plated steel is now used for 1p and 2p coins.

.....

.....

.....

(1 mark)

6

4.10.3.2 Alloys as useful materials

Question 14

March 2010 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about metals.

Match metals, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A iron

B aluminium

C gold

D stainless steel

1	It is found in the Earth as the metal itself.
2	It is an alloy which is resistant to corrosion.
3	It is extracted by reduction of its oxide in a blast furnace.
4	It is extracted from its oxide by electrolysis.

4.10.3.2 Alloys as useful materials

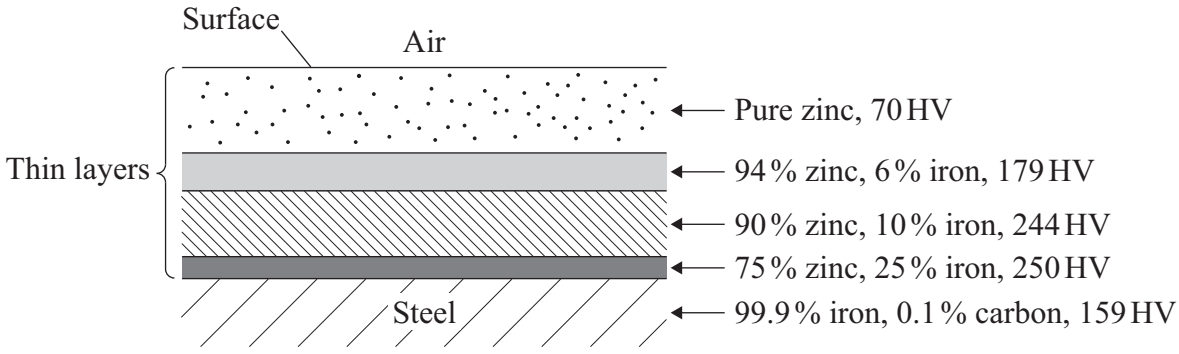
Question 15

March 2010 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Steel is dipped into molten zinc to prevent it from rusting. The zinc combines with the iron in the steel to form layers of zinc-iron alloys.

The diagram shows a cross-section through the layers.



HV is a unit of hardness. The higher the HV number, the harder the metal.

7A The diagram shows that . . .

1 the alloy layers are all of equal thickness.

2 all the layers are pure substances.

3 the steel is in contact with the air.

4 steel is harder than pure zinc.

7B The diagram shows that . . .

1 the amount of iron increases nearer the surface.

2 the percentage of zinc increases nearer the steel.

3 there is no pattern.

4 the percentage of zinc decreases nearer the steel.

4.10.3.2 Alloys as useful materials

Question 15 · continued March 2010 | CHY1AP | Original Q7 | Legacy

7C The diagram also shows that . . .

1 zinc is the hardest metal.

2 the zinc alloys are softer than steel.

3 increasing the iron content of the zinc alloys softens them.

4 for the zinc alloys, hardness increases with decreasing zinc content.

7D Steel car bodies are coated with zinc before painting.

This is to make them . . .

1 easier to recycle.

2 last longer.

3 weigh less.

4 more dense.

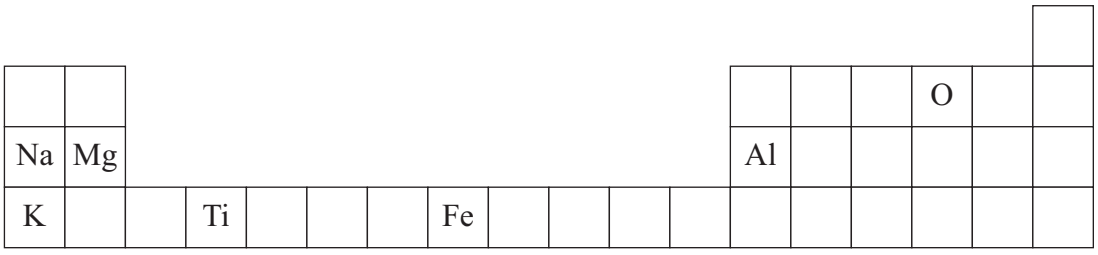
4.10.3.2 Alloys as useful materials

Question 16

March 2010 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

This is part of the periodic table.



8A What do the metals Fe (iron) and Ti (titanium) have in common?

1 They belong to the same group in the periodic table.

2 They are transition metals.

3 They do **not** conduct electricity.

4 They are resistant to corrosion.

8B When Fe (iron) and O (oxygen) react, iron atoms join with oxygen atoms to form iron oxide, Fe_2O_3

When this happens, . . .

1 the nuclei from iron and oxygen atoms join together.

2 electrons are lost and new atoms form.

3 electrons are transferred and chemical bonds hold the atoms together.

4 the nuclei are transferred and new atoms form.

8C Fe (iron) and O (oxygen) are in the periodic table but Fe_2O_3 (iron oxide) is not.

This is because iron oxide is . . .

1 an alloy.

2 a compound.

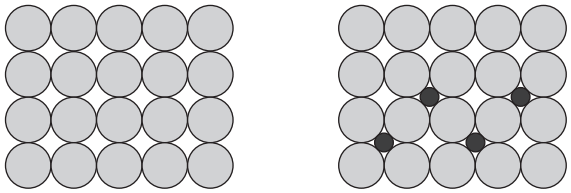
3 an ore.

4 a gas.

4.10.3.2 Alloys as useful materials

Question 16 · continued

8D The diagram shows the arrangement of atoms in pure iron and in steel.



Pure iron **Steel**

Which row in the table shows the metal that is harder **and** correctly explains why it is harder?

	Harder metal	Explanation
1	Pure iron	It contains only one type of atom.
2	Steel	The atoms cannot easily slide over each other.
3	Pure iron	The atoms cannot easily slide over each other.
4	Steel	It contains only one type of atom.

4.10.3.2 Alloys as useful materials

Question 17

June 2010 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

The table shows the composition and melting points of four alloys, **A**, **B**, **C** and **D**.

Alloy	Melting point in °C	Percentage composition (%)				
		Tin	Indium	Bismuth*	Lead*	Cadmium*
A	100	24.0	0	49.0	27.0	0
B	62	16.5	51.0	32.5	0	0
C	70	13.0	0	50.0	27.0	10.0
D	47	8.3	19.1	44.7	22.6	5.3

Toxic substances are marked with *.

Match alloys, **A**, **B**, **C** and **D**, with the numbers **1–4**.

1 It has the highest melting point.

2 It is made up from the largest number of substances.

3 It contains the least bismuth.

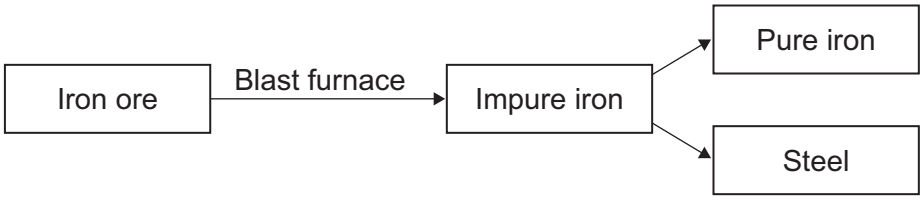
4 It contains the largest percentage of toxic substances.

4.10.3.2 Alloys as useful materials

Question 18 June 2010 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The flow chart shows how iron ore can be changed into useful materials.



8A Iron ore is the starting material for making iron because . . .

1 iron ore is magnetic.

2 iron ore contains a reasonable amount of iron oxide.

3 a lot of energy is needed to convert iron ore into iron.

4 mining iron ore does not cause any environmental problems.

8B In the blast furnace, iron oxide is converted to iron using carbon. This is because . . .

1 iron is less reactive than carbon.

2 iron is more reactive than carbon.

3 carbon is a cheap material to use.

4 carbon combines with the metal impurities in the iron ore, leaving iron.

8C Impure iron is hard and brittle. This is because in impure iron . . .

1 the impurities distort the layers of atoms so they cannot slide over each other.

2 the carbon breaks up the iron structure, allowing it to bend easily.

3 its structure has been destroyed by heating to a very high temperature.

4 all the atoms are the same and so remain in a regular arrangement.

8D When impure iron is converted into steel, . . .

1 all the carbon is removed and not replaced.

2 the amount of carbon is carefully controlled.

3 all the metal impurities are removed and not replaced.

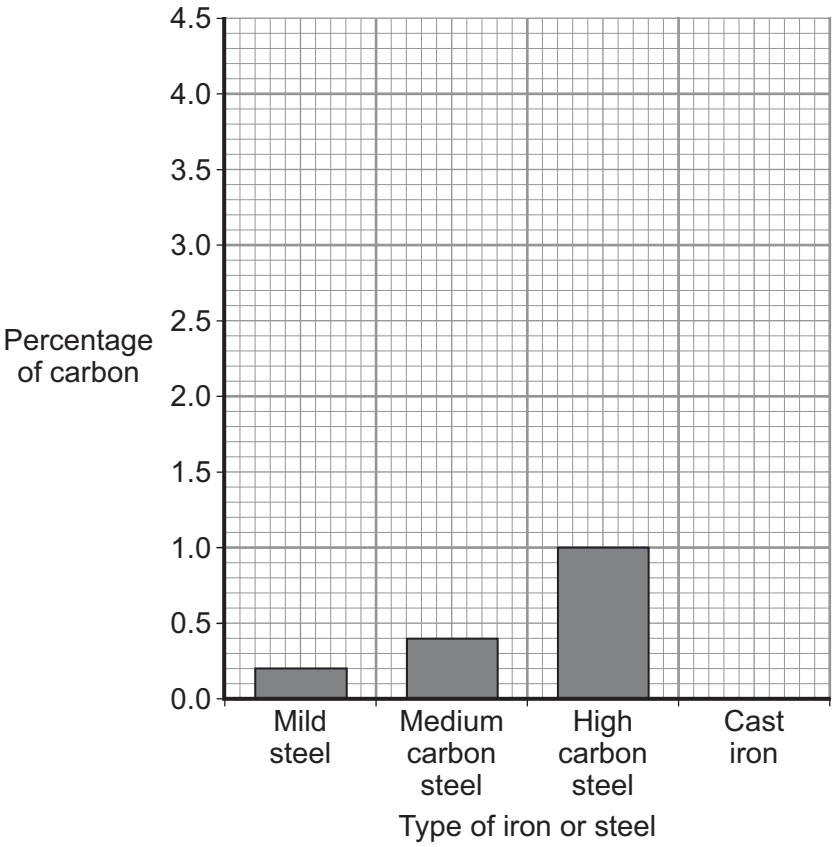
4 chromium is always added to the iron.

4.10.3.2 Alloys as useful materials

Question 19

June 2010 | CHY1F | Original Q2 | Legacy

2 The bar chart shows the percentage of carbon in three types of steel.



2 (a) Draw a ring around the correct word in the box to complete the sentence.

Steel is the name used for | alloys / atoms / ores | of iron.

(1 mark)

2 (b) Cast iron contains 4% carbon.

Draw the bar for cast iron on the chart.

(1 mark)

2 (c) Cast iron is more brittle than these three types of steel.

Use the bar chart to suggest why.

.....

.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 19 · continued June 2019 | CHY1F | Original Q2 | Legacy

2 (d) One type of stainless steel contains iron with 0.2% carbon to which 8% nickel and 18% chromium were added.

2 (d) (i) Tick (✓) the percentage of iron in this type of stainless steel.

Percentage (%) of iron	Tick (✓)
92.4	
88.6	
73.8	

(1 mark)

2 (d) (ii) Use the bar chart to name the type of steel that contains only 0.2% carbon.

.....

(1 mark)

2 (d) (iii) Draw a ring around the correct word in the box to complete the sentence.

Stainless steel is used for knives and forks because it is resistant to

corrosion.

decomposition.

distillation.

(1 mark)

6

4.10.3.2 Alloys as useful materials

Question 20

November 2010 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

The table shows some information about four metals, **A**, **B**, **C** and **D**.

	Metal	Date of discovery	Boiling point in °C	Position in reactivity series
A	Iron	Before 1200	2900	Middle
B	Aluminium	1827	2640	High
C	Copper	Before 1200	2570	Low
D	Calcium	1808	1480	High

Match metals, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table below.

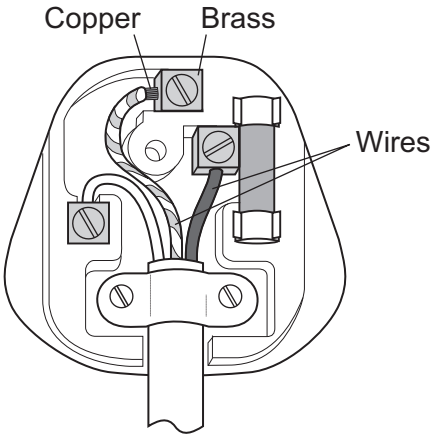
1	It is alloyed with carbon to make steel.
2	It was the last to be discovered.
3	It has the lowest boiling point.
4	It is the one most likely to be found as the metal itself.

4.10.3.2 Alloys as useful materials

Question 21

January 2011 | CHY1F | Original Q2 | Legacy

2 The diagram shows an electric plug.



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

Copper is used for the wires because it

conducts electricity.

conducts heat.

is shiny.

(1 mark)

2 (a) (ii) Brass is an *alloy* of copper and zinc.

What is an *alloy*?

.....

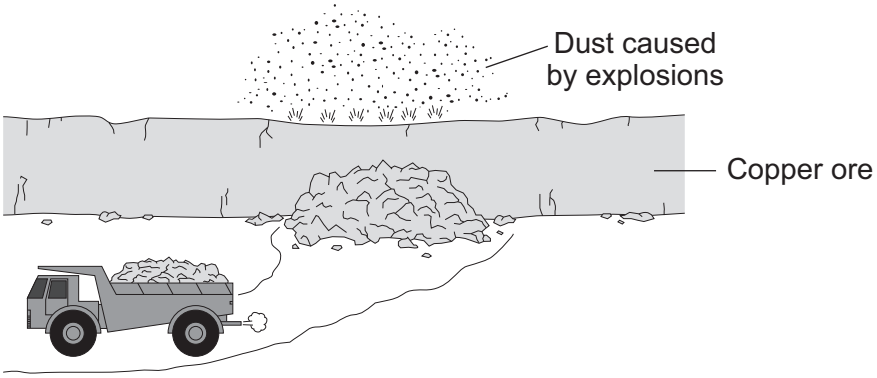
.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 21 · continued

2 (b) Open-cast mines are used to obtain copper ore.



Suggest **two** reasons why people would **not** like to live near an open-cast mine.

1 .....

.....

2 .....

.....

(2 marks)

4

4.10.3.2 Alloys as useful materials

Question 22

March 2011 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about uses of metals.

Match metals, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A Aluminium

B Calcium

C Copper

D Iron

1	When alloyed with carbon, this metal can form a hard steel.
2	Water pipes in the home are usually made from this metal.
3	Drinks cans are made from this metal because it does not easily corrode.
4	A carbonate of this metal is used to make quicklime.

4.10.3.2 Alloys as useful materials

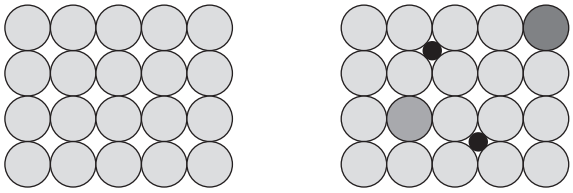
Question 23

June 2011 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

This question is about iron and different types of steel.

8A The diagrams show the arrangement of atoms in pure iron and in stainless steel.



Pure iron Stainless steel

Pure iron is soft and easily shaped because the atoms . . .

1 are not arranged in a regular pattern.

2 are small and spherical.

3 are in layers that can slide over each other.

4 are of different sizes.

8B Stainless steel rather than pure iron is used for making cutlery.

Which row in the table gives two reasons why stainless steel is used?

Stainless steel . . .		
1	is harder.	is a better heat conductor.
2	is more resistant to corrosion.	is harder.
3	is a better heat conductor.	can be more easily shaped.
4	can be more easily shaped.	is more resistant to corrosion.

4.10.3.2 Alloys as useful materials

Question 23 · continued June 2011 | CHY1AP | Original Q8 | Legacy

8C Which type of iron or steel is used to make hammer heads and chisels?

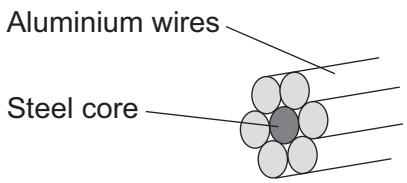
1 cast iron (iron from a blast furnace)

2 pure iron

3 low carbon steel

4 high carbon steel

8D The diagram shows the structure of an overhead power cable. The steel core gives strength to the cable.



Aluminium is used because it is a good conductor of electricity and . . .

1 it has a low density.

2 it is a good conductor of heat.

3 it can be hammered into shape.

4 it is a hard metal.

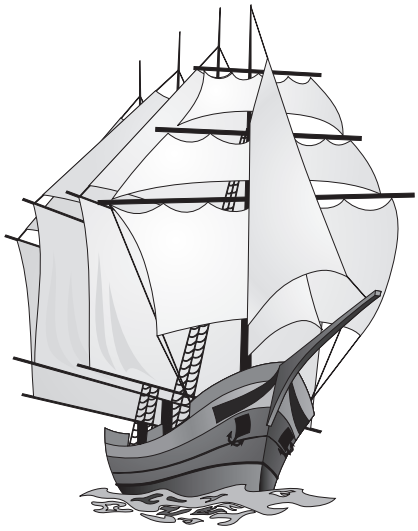
4.10.3.2 Alloys as useful materials

Question 24

June 2011 | CHY3F | Original Q6 | Legacy

6 Read the information about protecting the bottoms of ships.

A Copper-bottomed Investment



From the 16th to the 19th century, the bottoms of many wooden ships were protected from marine organisms by being covered with sheets of metal.

At first lead was used on the bottoms of ships, then copper was used until 1832 when Muntz Metal replaced it. Muntz Metal is an alloy of two transition metals, copper and zinc.

Table of data

	Lead	Copper	Muntz Metal
Cost (£/kg)	£1.20	£3.20	£2.30
Melting point (°C)	327	1083	904
Stops sea worms attacking wood	Yes	Yes	Yes
Stops barnacles and seaweed sticking to the bottom of the ship	No	Yes	Yes

4.10.3.2 Alloys as useful materials

Question 24 · continued June 2011 | CHY3F | Original Q6 | Legacy

6 (a) Use the information to answer the following questions.

6 (a) (i) Suggest why copper replaced lead.

.....

.....

(1 mark)

6 (a) (ii) Suggest why Muntz Metal replaced copper.

.....

.....

(1 mark)

6 (b) A sample of Muntz Metal contains a very small amount of iron as an impurity.

6 (b) (i) Name an instrumental method of analysis that could be used to detect iron.

.....

(1 mark)

6 (b) (ii) Suggest why an instrumental method would detect the iron in this sample of Muntz Metal but a chemical method is **not** likely to be successful.

.....

.....

(1 mark)

6 (c) Today, ships are made from steel. Steels are alloys of iron, a transition metal.

Give **two** properties of transition metals that make them suitable for making ships.

Property 1 .....

.....

Property 2 .....

.....

(2 marks)

6

4.10.3.2 Alloys as useful materials

Question 25

November 2011 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

This question is about iron and steel.

Match properties, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A hard

B resistant to corrosion

C easily shaped

D brittle

Iron from the blast furnace has few uses because it is . . . **1** . . . .

Low-carbon steel is used to make car body panels because it is . . . **2** . . . .

High-carbon steel is used to make knives because it is . . . **3** . . . .

Stainless steel is used to make kitchen sinks because it is . . . **4** . . . .

4.10.3.2 Alloys as useful materials

Question 26

2 Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.

2 (a) Reacting iron oxide with carbon produces iron.

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

The reaction to produce iron from iron oxide is

decomposition.

oxidation.

reduction.

(1 mark)

2 (b) Aluminium cannot be produced by reacting aluminium oxide with carbon.

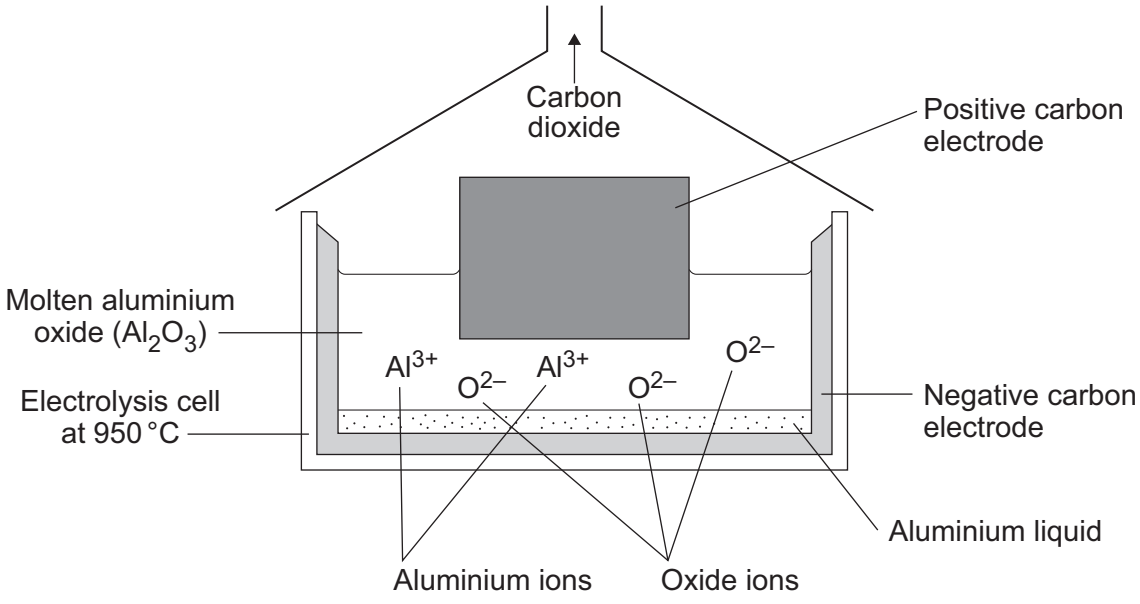
Why does aluminium oxide **not** react with carbon?

Tick (✓) the correct answer.

Answer	Tick (✓)
aluminium is less reactive than carbon	
carbon is less reactive than aluminium	
oxygen is more reactive than carbon	

(1 mark)

2 (c) Aluminium can be produced by electrolysis.



Question 26 · continued

Why do the aluminium ions collect at the negative electrode?

.....

.....

.....

.....

(2 marks)

2 (d) Some statements about aluminium are given below.

Tick (✓) **two** statements that are correct reasons why aluminium is used to make cans.

Statement	Tick (✓)
aluminium conducts electricity	
aluminium is not a transition metal	
aluminium has a low density	
aluminium is resistant to corrosion	

(2 marks)

2 (e) Recycling aluminium cans uses less fossil fuels than producing aluminium from its ore.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of recycling aluminium to make aluminium cans.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
aluminium is the most common metal in the Earth's crust		
less carbon dioxide is produced		
more aluminium ore needs to be mined		
used aluminium cans have to be collected and transported		

(2 marks)

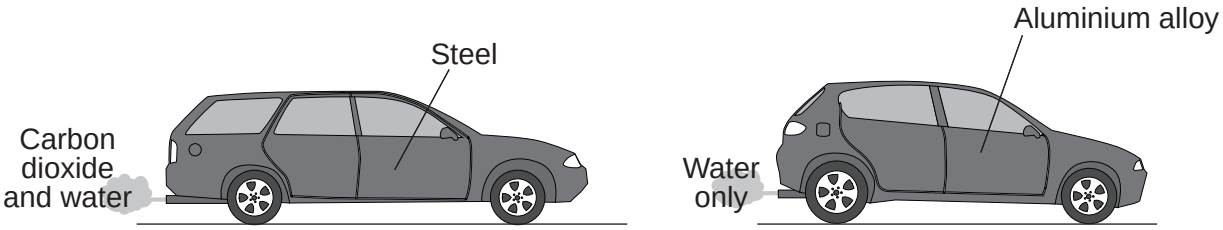
8

4.10.3.2 Alloys as useful materials

Question 27

June 2012 | CH1FP | Original Q3 | Legacy

3 The picture shows two different cars.



3 (a) Some properties of aluminium are given below.

Tick (✓) **two** reasons why aluminium is better than steel for car bodies.

Reason	Tick (✓)
Aluminium is not a transition metal.	
Aluminium has a low density.	
Aluminium is expensive to extract.	
Aluminium is resistant to corrosion.	

(2 marks)

3 (b) Each car body is made from an *alloy*.

3 (b) (i) What is an *alloy*?

.....

.....

(1 mark)

3 (b) (ii) An alloy is used to make a car body. A pure metal is **not** used to make a car body.

Suggest why.

.....

.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 27 · continued June 2012 | CH1FP | Original Q3 | Legacy

3 (c) The car with a steel body uses petrol for fuel.

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

3 (c) (i) Petrol is made from

air.
crude oil.
metal ores.

(1 mark)

3 (c) (ii) Petrol is a mixture of

carbonates
hydrocarbons
polymers

including C_8H_{18}

(1 mark)

3 (c) (iii) In the car engine petrol reacts with

argon
nitrogen
oxygen

to produce carbon dioxide and water.

(1 mark)

3 (d) Look at the substances coming out of each car's exhaust.

3 (d) (i) Suggest the name of the fuel used in the car with the aluminium alloy body.

Name of fuel .....

(1 mark)

3 (d) (ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

.....

.....

(1 mark)

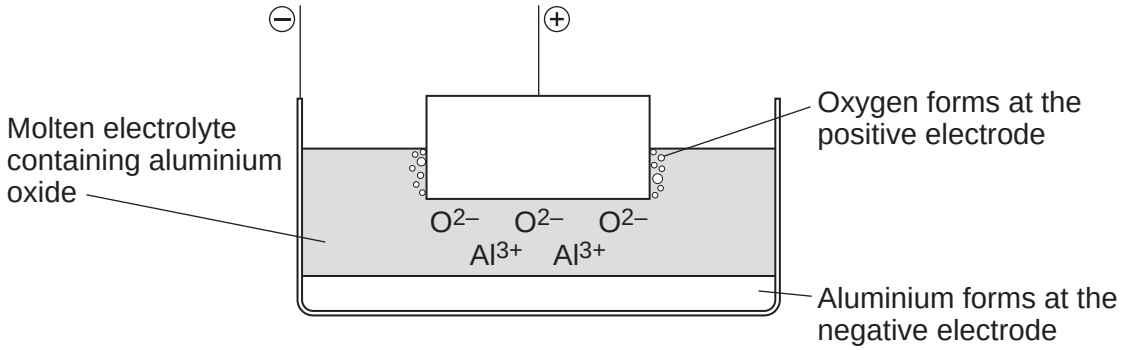
9

4.10.3.2 Alloys as useful materials

Question 28

June 2012 | CH2FP | Original Q4 | Legacy

4 The diagram represents an electrolysis cell for extracting aluminium.
The current will only flow when the electrolyte is molten.



4 (a) The electrolyte is aluminium oxide mixed with another substance.

4 (a) (i) What is the name of the other substance in the electrolyte?

Draw a ring around the correct answer.

cryolite **rock salt** **limestone**

(1 mark)

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

This other substance is added to

condense the aluminium oxide.
lower the melting point of the aluminium oxide.
raise the boiling point of the aluminium oxide.

(1 mark)

4 (b) (i) Oxide ions (O^{2-}) move to the positive electrode.

Explain why.

.....

.....

.....

.....

(2 marks)

4.10.3.2 Alloys as useful materials

Question 28 · continued June 2012 | CH2FP | Original Q4 | Legacy

4 (b) (ii) Oxygen is formed at the positive electrode. The oxygen then forms carbon dioxide.

The equation for the reaction is shown below.

$$C + O_2 \rightarrow CO_2$$

Complete the sentence.

The name of the element which reacts with oxygen is ..... .

(1 mark)

4 (b) (iii) The positive electrode gets smaller.

Suggest why.

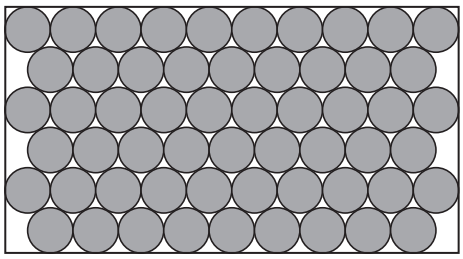
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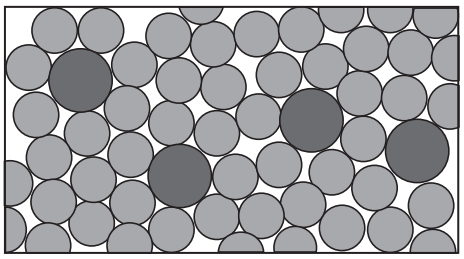
(1 mark)

4 (c) Aluminium is used in an alloy with magnesium to make drinks cans.

The diagrams show the arrangement of atoms in pure aluminium and in the alloy.



Pure aluminium



Alloy

The alloy is harder than pure aluminium.

Explain why. Use the diagrams to help you.

.....

.....

.....

.....

(2 marks)

8

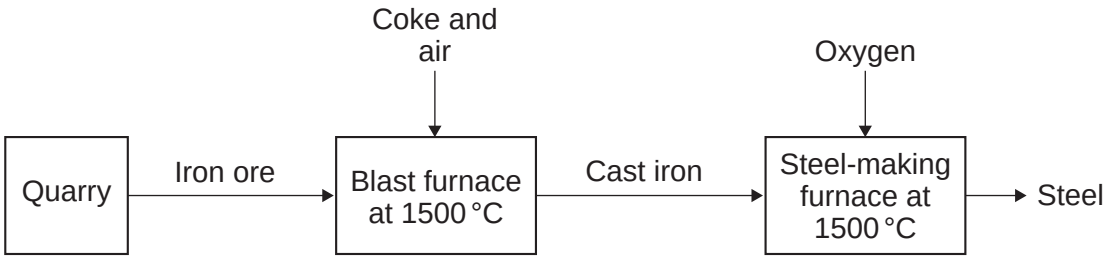
4.10.3.2 Alloys as useful materials

Question 29

January 2013 | CH1FP | Original Q4 | Legacy

4 The iron produced from iron ore in a blast furnace is called cast iron.

Cast iron is converted into steel in a furnace.



Iron ore contains iron oxide.
Coke contains carbon.

4 (a) Quarrying iron ore will have an impact on everything near to the quarry.

4 (a) (i) Describe **one** positive impact and **one** negative impact of quarrying iron ore.

positive impact .....

.....

negative impact.....

.....

(2 marks)

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

Ores contain enough metal to make extraction of the metal

carbon neutral.

economical.

reversible.

(1 mark)

4 (b) Many chemical reactions take place in a blast furnace.
Use the flow diagram to help you to answer this question.

Suggest how the blast furnace is heated.

.....

.....

(1 mark)

4.10.3.2 Alloys as useful materials

Question 29 · continued January 2013 | CH1FP | Original Q4 | Legacy

4 (c) A chemical reaction for the extraction of iron is:

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

4 (c) (i) Complete the word equation for this chemical reaction.

..... + carbon monoxide → iron + ...

(2 marks)

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

Iron is extracted from its ore by

- decomposition.
- oxidation.
- reduction.

(1 mark)

4 (d) Cast iron contains about 4% carbon.
Cast iron is converted into low-carbon steels.

4 (d) (i) Low-carbon steel is produced by blowing oxygen into molten cast iron.

Suggest how oxygen removes most of the carbon.

.....

.....

.....

.....

(2 marks)

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

Metals, such as nickel, are added to low-carbon steels to make the steel

- corrode easily.
- easy to shape.
- much harder.

(1 mark)

Question 4 continues on the next page

4.10.3.2 Alloys as useful materials

Question 29 · continued

4 (e) Recycling steel uses less energy than producing steel from iron ore**.**

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of recycling steel.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
Iron is the second most common metal in the Earth's crust.		
Less carbon dioxide is produced.		
More iron ore needs to be mined.		
There are different types of steel which must be sorted.		

(2 marks)

12

4.10.3.2 Alloys as useful materials

Question 30

January 2013 | CH2FP | Original Q6 | Legacy

6 Printed pictures can be made using etchings.



An etching can be made when a sheet of brass reacts with iron chloride solution.

6 (a) Brass is a mixture of two metals, copper and zinc.

6 (a) (i) A mixture of two metals is called ..... .

(1 mark)

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

Copper and zinc atoms are different sizes.

This makes brass | harder | more flexible | softer | than the pure metals.

(1 mark)

4.10.3.2 Alloys as useful materials

Question 30 · continued

6 (b) Iron chloride has the formula $FeCl_3$

Relative atomic masses (A_r): Cl = 35.5; Fe = 56.

6 (b) (i) Calculate the relative formula mass (M_r) of iron chloride ($FeCl_3$).

.....

.....

.....

Relative formula mass (M_r) of iron chloride = ...

(2 marks)

6 (b) (ii) Calculate the percentage of iron in iron chloride ($FeCl_3$).

.....

.....

.....

Percentage of iron in iron chloride = ...%

(2 marks)

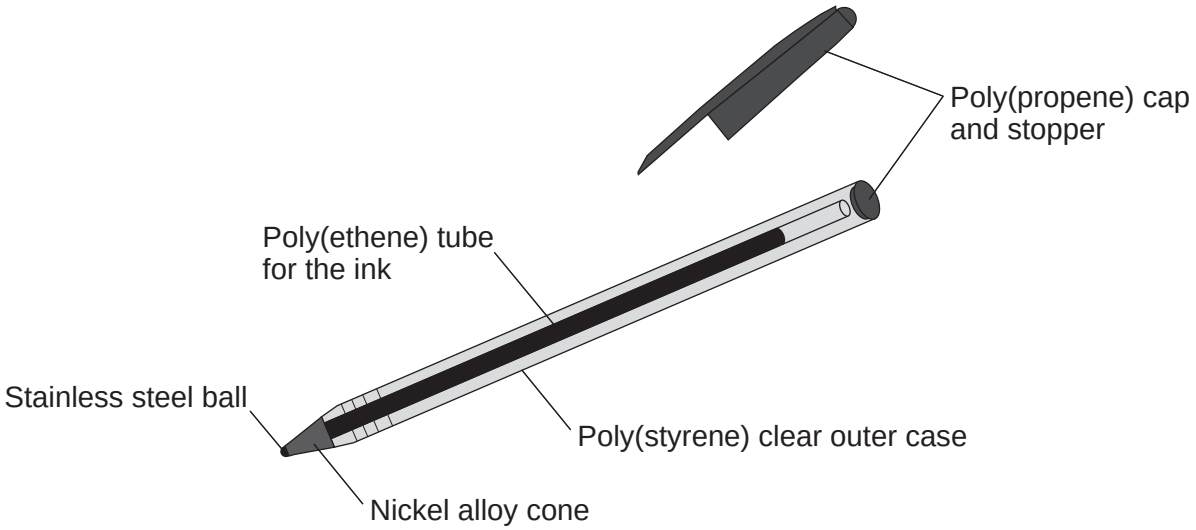
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4.10.3.2 Alloys as useful materials

Question 31

June 2013 | CH1FP | Original Q5 | Legacy

5 The diagram shows a ballpoint pen.



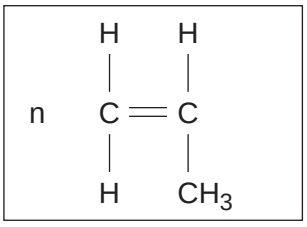
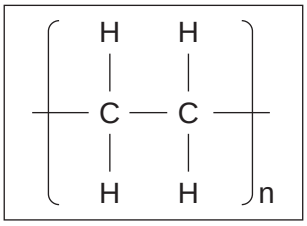
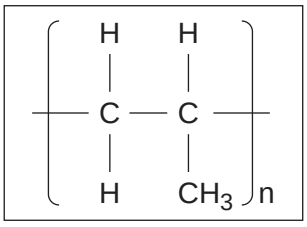
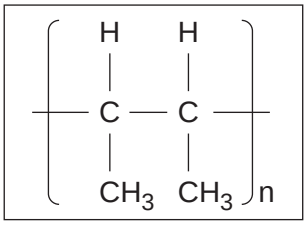
5 (a) Polymers are used to make the ballpoint pen.

5 (a) (i) Name the monomer used to make poly(ethene).

.....

(1 mark)

5 (a) (ii) Draw **one** line from the monomer propene to its polymer poly(propene).

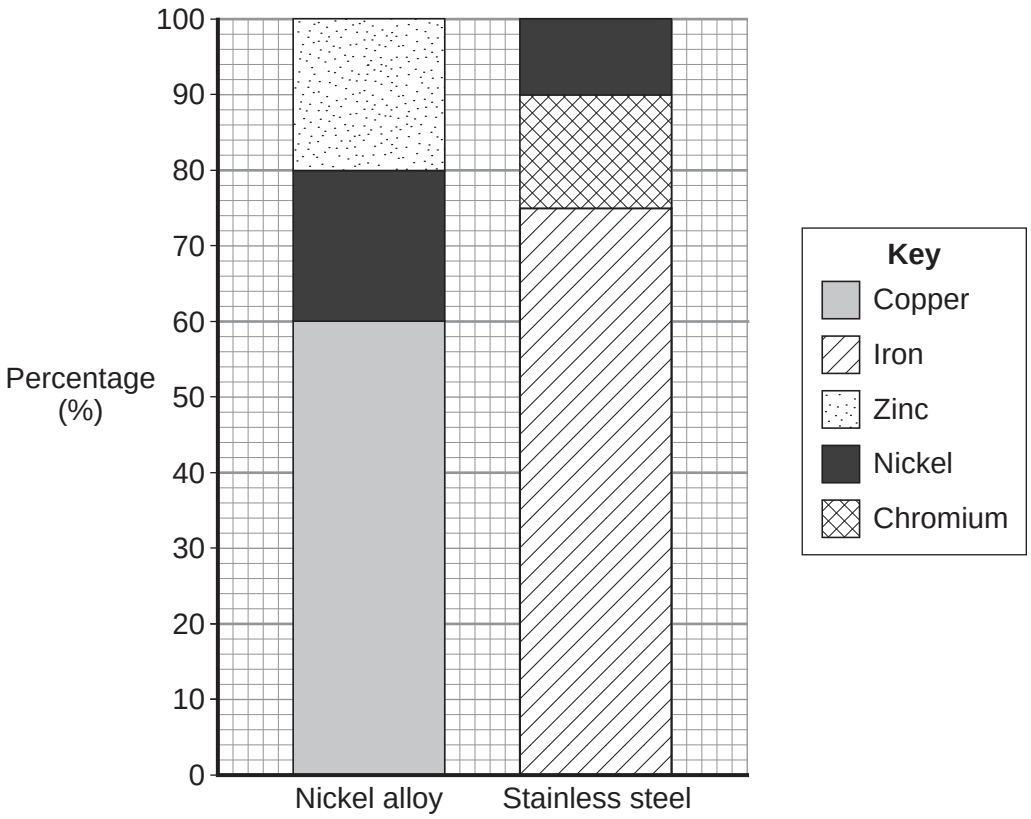
Monomer	**Polymer**
	
	
	

(1 mark)

4.10.3.2 Alloys as useful materials

Question 31 · continued June 2013 | CH1FP | Original Q5 | Legacy

5 (b) Two alloys are used to make the ballpoint pen.



Use the bar chart to answer these questions.

5 (b) (i) Which metal is in both of these alloys? .....

(1 mark)

5 (b) (ii) What is the percentage of iron in the stainless steel? ..... %

(1 mark)

4.10.3.2 Alloys as useful materials

Question 31 · continued June 2013 | CH1FP | Original Q5 | Legacy

5 (b) (iii) The alloy stainless steel is used instead of pure iron for the ball of the pen.
Give **two** reasons why.

.....

.....

.....

.....

(2 marks)

5 (c) Tick (✓) **one** advantage and tick (✓) **one** disadvantage of **recycling** this type of ballpoint pen.

	Advantage Tick (✓)	**Disadvantage Tick (✓)**
Can be refilled and reused		
Conserves resources of crude oil and ores		
High cost of separating materials		
Polymers and alloys are not expensive		

(2 marks)

8

4.10.3.2 Alloys as useful materials

Question 32

June 2013 | CH2FP | Original Q3 | Legacy

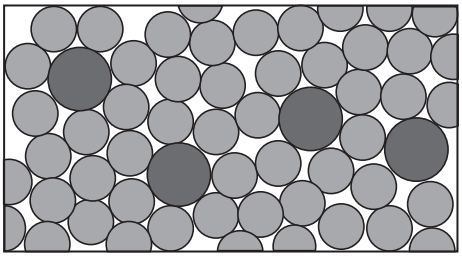
3 Oil rigs are used to drill for crude oil.



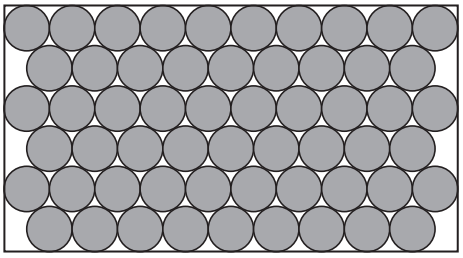
3 (a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.

Alloy



Pure iron



Use the diagrams to explain why the alloy is harder than pure iron.

.....

.....

.....

.....

(2 marks)

3 (b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

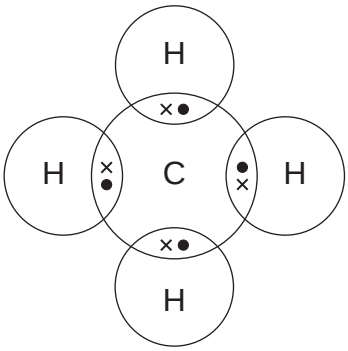
Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2 marks)

4.10.3.2 Alloys as useful materials

Question 32 · continued

3 (c) Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.



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

Methane is

a compound.

an element.

a mixture.

(1 mark)

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

The formula of methane is

C_4H_4

C_4H

CH_4

(1 mark)

3 (c) (iii) Name the type of bond between the carbon and hydrogen atoms in methane.

.....

(1 mark)

3 (d) Explain why methane is a gas at 20 °C.

.....

.....

.....

.....

(2 marks)

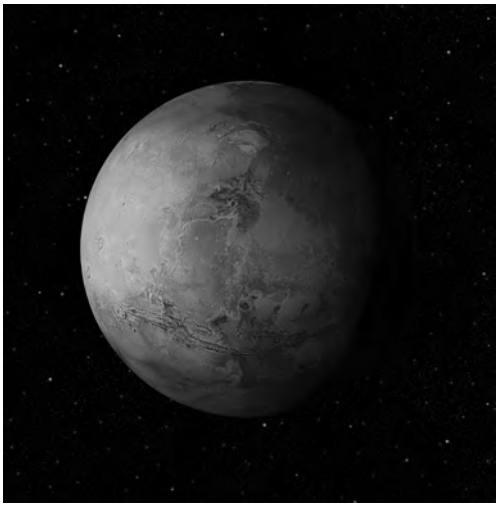
9

4.10.3.2 Alloys as useful materials

Question 33

June 2013 | CH2FP | Original Q5 | Legacy

5 This question is about the planet Mars.



5 (a) Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

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

Ionic compounds are made of

- giant lattices.
- polymer chains.
- simple molecules.

(1 mark)

5 (b) Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

5 (b) (i) Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

Suggest how the polymers could be made to return to their original shape.

.....

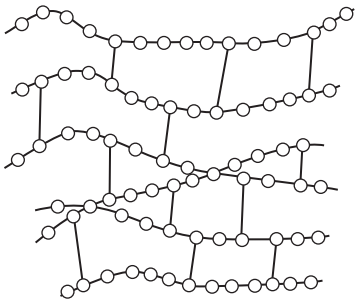
(1 mark)

4.10.3.2 Alloys as useful materials

Question 33 · continued June 2013 | CH2FP | Original Q5 | Legacy

5 (b) (ii) Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

(2 marks)

5 (c) Instrumental methods such as GC–MS are used to analyse substances found on Mars.

In GC–MS, gas chromatography columns are linked to mass spectrometers.

5 (c) (i) What does gas chromatography do to the substances?

.....

.....

(1 mark)

5 (c) (ii) Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

.....

(2 marks)

7

4.10.3.2 Alloys as useful materials

Question 34

June 2014 | CH2FP | Original Q2 | Legacy

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



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

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

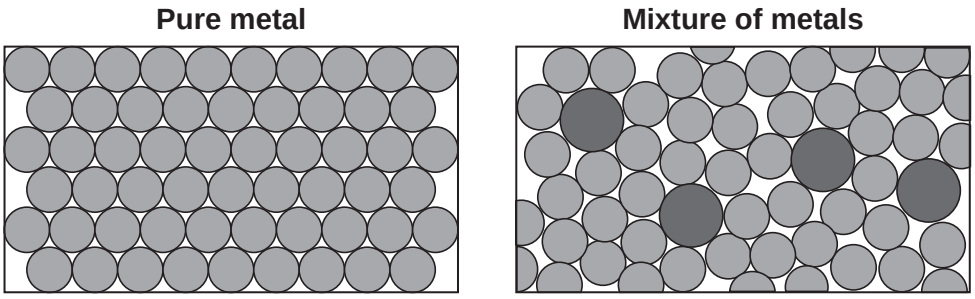
[1 mark]

Nitinol is a shape memory

- alloy.
- catalyst.
- polymer.

2 (b) **Figure 2** shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2



The mixture of metals is harder than the pure metal.

Use **Figure 2** to explain why.

[2 marks]

.....

.....

.....

.....

4.10.3.2 Alloys as useful materials

Question 34 · continued

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 marks]

.....

.....

.....

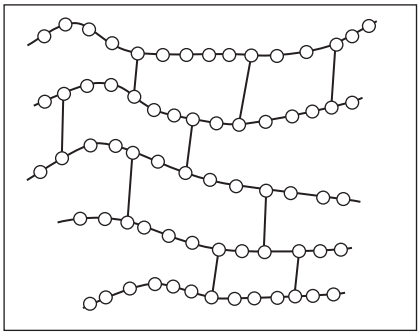
.....

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

Figure 3 shows the structure of a thermosetting polymer.

Figure 3

Thermosetting polymer



How can you tell from **Figure 3** that the polymer is thermosetting?

[1 mark]

.....

.....

6

4.10.3.2 Alloys as useful materials

Question 35

June 2016 | CH1FP | Original Q3 | Legacy

3 Metals are extracted from ores in the Earth's crust.

3 (a) Why is copper used in the manufacture of computers?

[1 mark]

Tick (✓) **one** box.

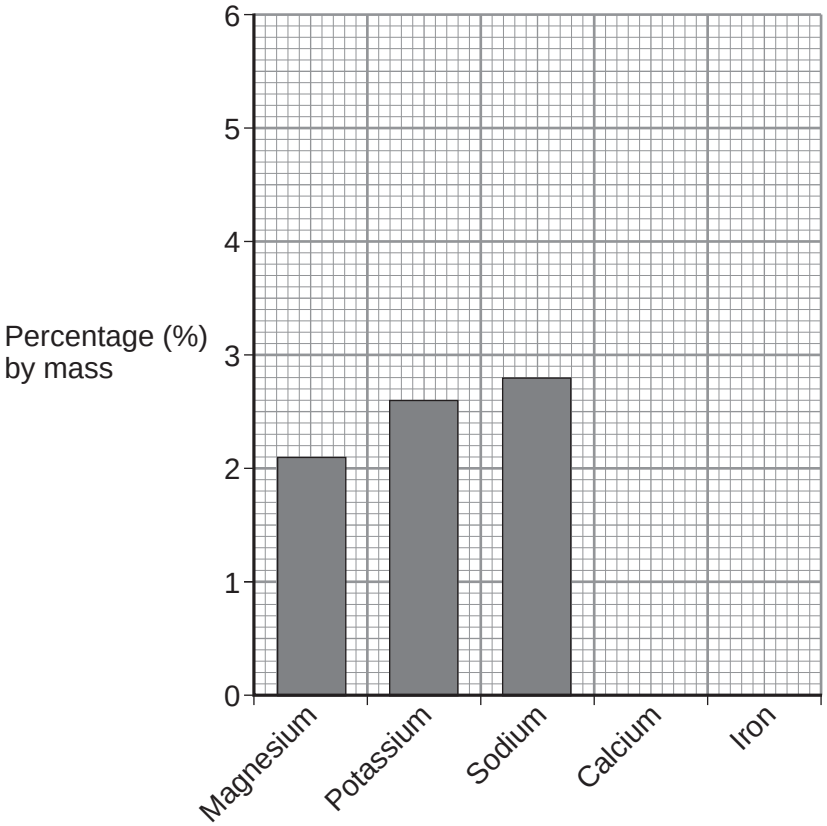
Because it has a high density. ☐

Because it does not react with water. ☐

Because it is a good conductor of electricity. ☐

3 (b) **Figure 6** shows the percentage (%) by mass of some metals in the Earth's crust.

Figure 6



4.10.3.2 Alloys as useful materials

Question 35 · continued

3 (b) (i) What is the percentage by mass of magnesium in the Earth's crust?

[1 mark]

_____ %

3 (b) (ii) On **Figure 6** draw the bars for:

- calcium at 3.6% by mass
- iron at 5.0% by mass.

[2 marks]

3 (c) An ore of zinc contains zinc carbonate.

The equation for the reaction when zinc carbonate is heated is:

$$\underset{\text{zinc carbonate}}{ZnCO_3} \longrightarrow \underset{\text{zinc oxide}}{ZnO} + \underset{\text{carbon dioxide}}{CO_2}$$

3 (c) (i) What is the name of this type of reaction?

[1 mark]

Tick (✓) **one** box.

corrosion ☐

decomposition ☐

electrolysis ☐

3 (c) (ii) Which substance in the equation is a gas at room temperature (20 °C)?

[1 mark]

Tick (✓) **one** box.

zinc carbonate ☐

zinc oxide ☐

carbon dioxide ☐

Question 3 continues on the next page

4.10.3.2 Alloys as useful materials

Question 35 · continued

3 (c) (iii) Complete **Table 1** to show the number of atoms of carbon and oxygen in the formula of zinc carbonate.

[2 marks]

Table 1

Element	Number of atoms in the formula $ZnCO_3$
zinc, Zn	1
carbon, C	
oxygen, O	

3 (c) (iv) When 125 g zinc carbonate is heated, 81 g zinc oxide is produced.

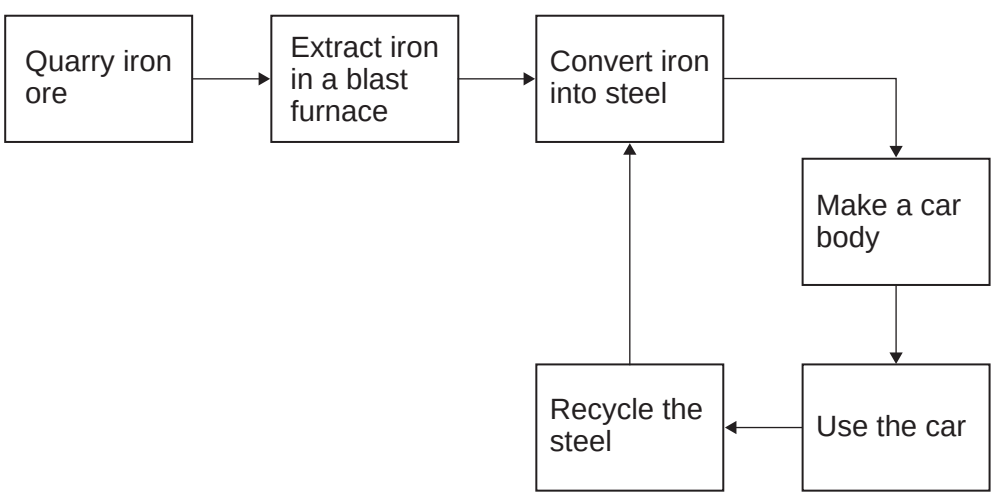
Calculate the mass of carbon dioxide produced.

[1 mark]

Mass of carbon dioxide = _____ g

3 (d) **Figure 7** shows a simple life cycle of a car body.

Figure 7



4.10.3.2 Alloys as useful materials

Question 35 · continued

3 (d) (i) What is **one** reason why iron from the blast furnace is converted into steel?

[1 mark]

Tick (✓) **one** box.

To make the iron pure. ☐

To make the iron more brittle. ☐

To make alloys for specific uses. ☐

3 (d) (ii) Apart from cost, give **three different** reasons why steel should be recycled.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

13

4.10.3.2 Alloys as useful materials

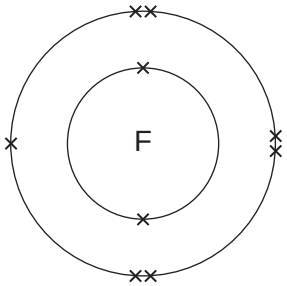
Question 36

June 2016 | CH2FP | Original Q1 | Legacy

1 This question is about fluorine.

1 (a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



1 (a) (i) In which group of the periodic table is fluorine?

[1 mark]

Group _____

1 (a) (ii) Complete **Table 1** to show the particles in an atom and their relative masses.

[2 marks]

Table 1

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

1 (a) (iii) Use the correct answer from the box to complete the sentence.

[1 mark]

alkalis	**alloys**	**isotopes**

Atoms of fluorine with different numbers of neutrons are called _____ .

4.10.3.2 Alloys as useful materials

Question 36 · continued

1 (b) Sodium reacts with fluorine to produce sodium fluoride.

1 (b) (i) Complete the word equation for this reaction.

[1 mark]

sodium + _____ ⟶ _____

1 (b) (ii) Complete the sentence.

[1 mark]

Substances in which atoms of two or more different elements are chemically combined are called _____ .

1 (b) (iii) The relative formula mass (M_r) of sodium fluoride is 42.

Use the correct answer from the box to complete the sentence.

[1 mark]

ion	mole	molecule

The relative formula mass (M_r), in grams, of sodium fluoride is one _____ of the substance.

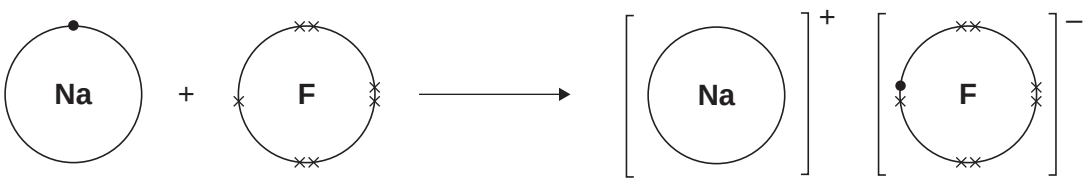
Question 1 continues on the next page

Question 36 · continued

1 (b) (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

Figure 2



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

[4 marks]

4.10.3.2 Alloys as useful materials

Question 36 · continued

1 (b) (v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

[2 marks]

Tick (✓) **two** boxes.

- Dissolve in water ☐
- Gas at room temperature ☐
- High melting point ☐
- Low boiling point ☐

13

Turn over for the next question

4.10.3.2 Alloys as useful materials

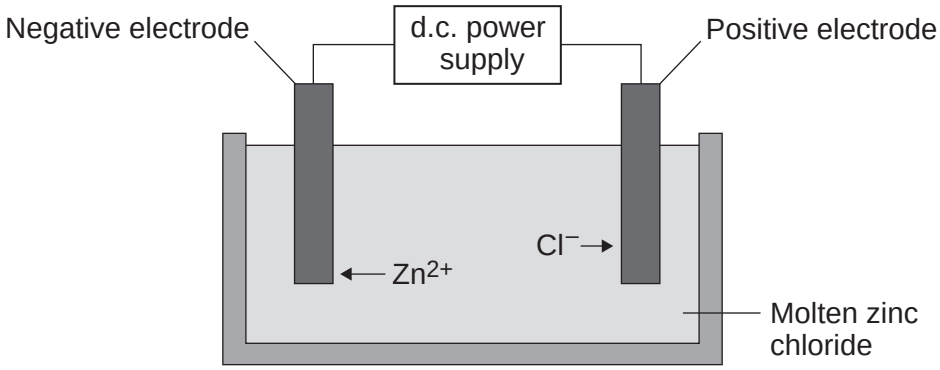
Question 37

June 2016 | CH2FP | Original Q3 | Legacy

3 This question is about zinc.

Figure 7 shows the electrolysis of molten zinc chloride.

Figure 7



3 (a) Zinc chloride is an ionic substance.
Complete the sentence.

[1 mark]

When zinc chloride is molten, it will conduct _____ .

3 (b) Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

3 (b) (i) Name the product formed at the positive electrode.

[1 mark]

_____

3 (b) (ii) Explain why zinc ions move towards the negative electrode.

[2 marks]

_____

_____

_____

_____

4.10.3.2 Alloys as useful materials

Question 37 · continued

3 (b) (iii) What type of reaction occurs when the zinc ions gain electrons?

[1 mark]

Tick (✓) **one** box.

Neutralisation ☐

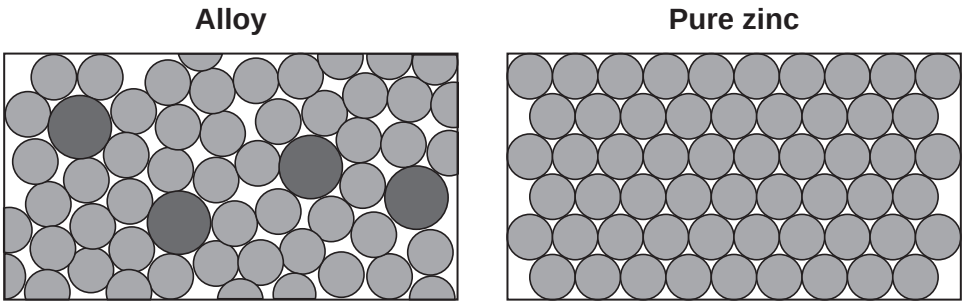
Oxidation ☐

Reduction ☐

3 (c) Zinc is mixed with copper to make an alloy.

3 (c) (i) **Figure 8** shows the particles in the alloy and in pure zinc.

Figure 8



Use **Figure 8** to explain why the alloy is harder than pure zinc.

[2 marks]

_____

_____

_____

_____

3 (c) (ii) Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

[1 mark]

_____

8

4.10.3.2 Alloys as useful materials

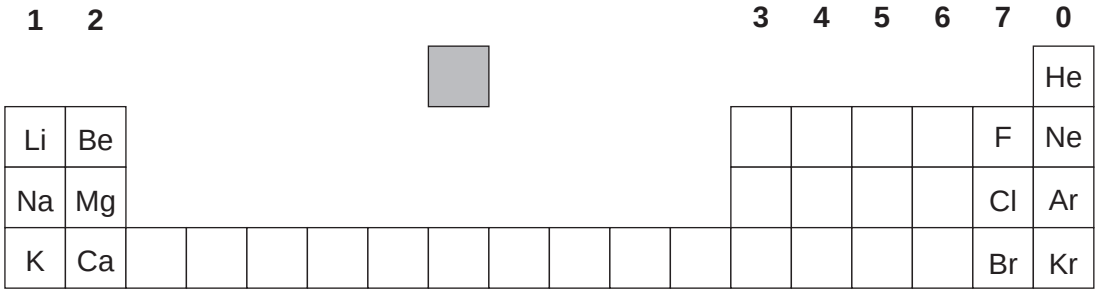
Question 38

June 2017 | CH1FP | Original Q2 | Legacy

2 Use the Chemistry Data Sheet to help you answer this question.

Figure 2 shows part of the periodic table.

Figure 2



2 (a) Give the name of the element that should be in the shaded box.

[1 mark]

_____

2 (b) How many different elements are there in the complete periodic table?

[1 mark]

Tick (✓) **one** box.

About 36 ☐

About 100 ☐

About 500 ☐

4.10.3.2 Alloys as useful materials

Question 38 · continued

2 (c) What are **two** reasons why lithium, sodium and potassium are in the same group of the periodic table?

[2 marks]

Tick (✓) **two** boxes.

- Low melting points ☐
- Same number of electrons in the outer shell ☐
- Similar atomic (proton) numbers ☐
- Similar chemical reactions ☐
- Two electrons in the innermost shell ☐

2 (d) Complete each sentence.

[2 marks]

The elements in Group 0 are called _____ gases.

The elements in the central block are known as _____ metals.

2 (e) Use the correct word from the box to complete each sentence.

[2 marks]

alloys	ions	molecules	polymers	protons

Atoms of fluorine gain electrons to form fluoride _____ .

Atoms of fluorine share electrons to form fluorine _____ .

8

4.10.3.2 Alloys as useful materials

Question 39

June 2017 | CH2FP | Original Q2 | Legacy

2 This question is about sulfuric acid, copper sulfate and ethene.

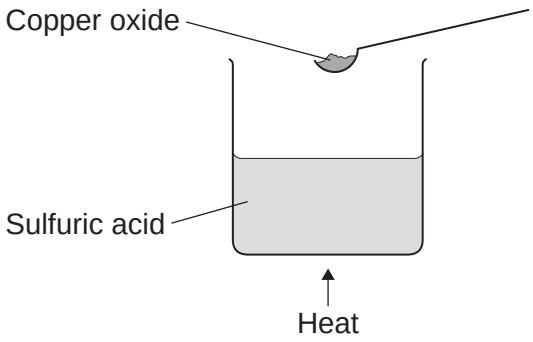
2 (a) A student added copper oxide to sulfuric acid to make copper sulfate.

The word equation for the reaction is:

sulfuric acid + copper oxide ⟶ copper sulfate + water

Figure 4 shows the first stage of the student's method.

Figure 4



2 (a) (i) The state symbol for CuO is missing from the equation below.

Use the correct answer from the box to complete the equation.

[1 mark]

aq	g	l	s

H_2SO_4 (aq) + CuO (___) ⟶ $CuSO_4$ (aq) + H_2O (l)

2 (a) (ii) Why is the sulfuric acid heated?

[1 mark]

_____

_____

Question 2 continues on the next page

4.10.3.2 Alloys as useful materials

Question 39 · continued

2 (a) (iii) Which of these values could be the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☐

7 ☐

11 ☐

14 ☐

2 (a) (iv) Why does the student continue to add copper oxide until some is left at the end of the reaction?

[1 mark]

Tick (✓) **one** box.

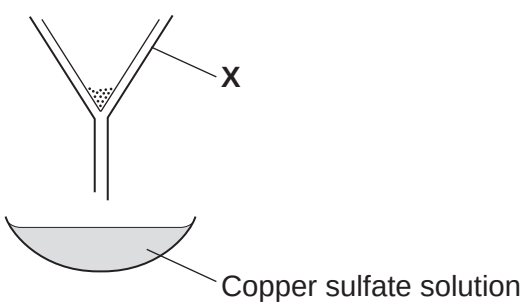
To make bigger copper sulfate crystals. ☐

To make sure all the copper oxide has reacted. ☐

To make sure all the sulfuric acid has reacted. ☐

2 (b) **Figure 5** shows the second stage of the student's method.

Figure 5



4.10.3.2 Alloys as useful materials

Question 39 · continued

2 (b) (i) Name the apparatus labelled **X** on **Figure 5**.

[1 mark]

_____

2 (b) (ii) What could the student do to the copper sulfate solution to get copper sulfate crystals?

[1 mark]

_____

_____

2 (c) The student weighed the copper sulfate crystals.

Why was the mass of the copper sulfate crystals less than the student expected?

[1 mark]

Tick (✓) **one** box.

The student added too much copper oxide. ☐

The student left some copper sulfate crystals in the apparatus. ☐

The student weighed the copper sulfate crystals when they were wet. ☐

2 (d) The equation shows the reaction when blue hydrated copper sulfate crystals are heated.

hydrated copper sulfate $\rightleftharpoons$ anhydrous copper sulfate + water

2 (d) (i) What colour is anhydrous copper sulfate?

[1 mark]

_____

2 (d) (ii) What would you see if water is added to anhydrous copper sulfate?

[1 mark]

_____

4.10.3.2 Alloys as useful materials

Question 39 · continued

2 (e) Ethene and sulfuric acid are used to make many substances.

Table 1 shows data about wealth of countries, ethene production and sulfuric acid production.

Table 1

Country	Wealth of country in billions of dollars	Ethene production in kilotonnes	Sulfuric acid production in kilotonnes
A	4000	13 900	36 000
B	1300	4 400	6 600
C	1290	2 700	26 000
D	460	1 500	2 500

2 (e) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

alloys	chlorine	graphite	polymers

Ethene is used to make _____ .

2 (e) (ii) Describe the relationship, if any, between the wealth of a country and the production of ethene.

[1 mark]

_____

_____

2 (e) (iii) Describe the relationship, if any, between the wealth of a country and the production of sulfuric acid.

[1 mark]

_____

_____

12

4.10.3.2 Alloys as useful materials

Question 40

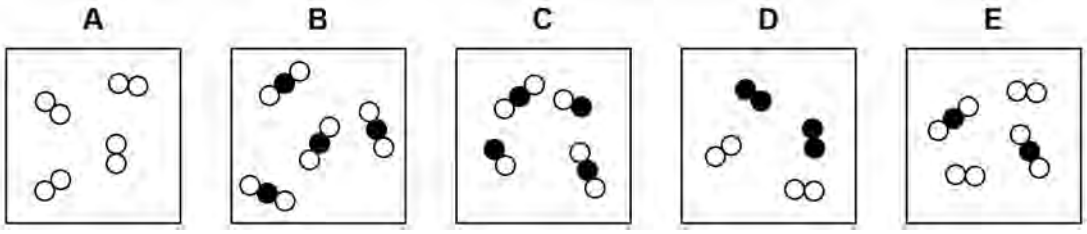
June 2019 | 8462/1F | Original Q3

0 3 This question is about elements, compounds and mixtures.

Figure 5 shows five different substances, **A**, **B**, **C**, **D** and **E**.

○ and ● represent atoms of different elements.

Figure 5



Use **Figure 5** to answer Questions **03.1** to **03.3**

0 3 . 1 Which substance is only one compound?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 3 . 2 Which substance is a mixture of elements?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 3 . 3 Which substance is a mixture of an element and a compound?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

4.10.3.2 Alloys as useful materials

Question 40 · continued

Substances are separated from a mixture using different methods.

0 3 . 4 Draw **one** line from each method of separation to the substance and mixture it would separate.

[2 marks]

Method of separation	Substance and mixture
	blue food colour from a mixture of food colours
chromatography	
	copper from an alloy of copper and zinc
	copper sulfate from copper sulfate solution
crystallisation	
	ethanol from a mixture of ethanol and water

4.10.3.2 Alloys as useful materials

Question 40 · continued

0 3 . 5 Sand does not dissolve in water. A student separates a mixture of sand and water by filtration.

Draw a diagram of the apparatus the student could use.

You should label:

- where the sand is collected
- where the water is collected.

[3 marks]

Diagram

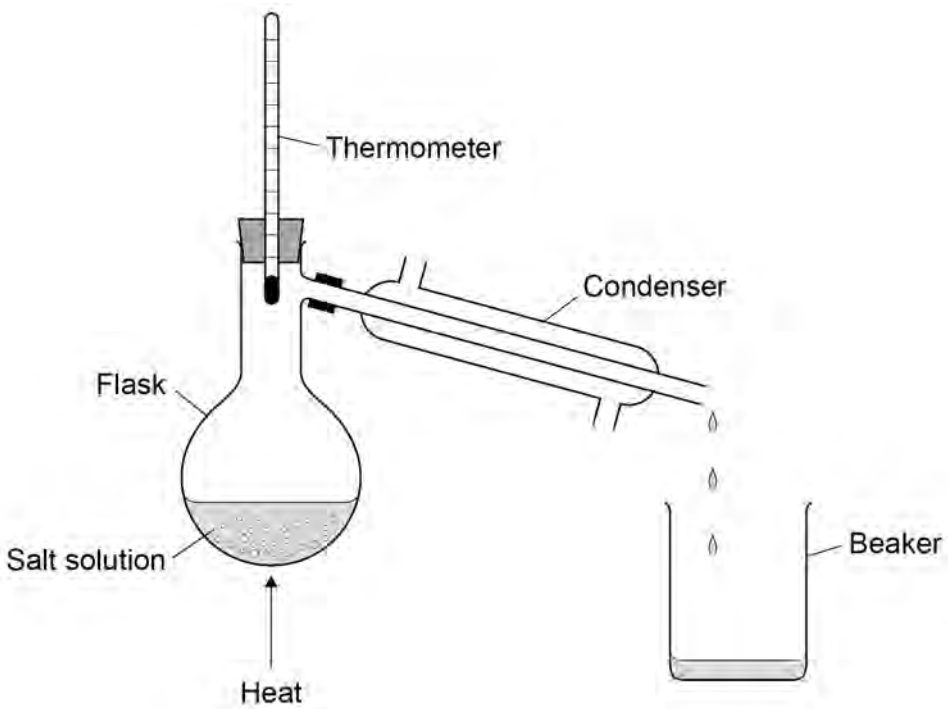
Question 3 continues on the next page

Question 40 · continued

0 3 . 6 A student distils a sample of salt solution to produce pure water.

Figure 6 shows the apparatus.

Figure 6



What temperature would you expect the thermometer to show?

[1 mark]

Tick (✓) **one** box.

0 °C ☐

10 °C ☐

50 °C ☐

100 °C ☐

4.10.3.2 Alloys as useful materials

Question 40 · continued

0 3 . 7 Describe how the process of distillation shown in **Figure 6** produces pure water from salt solution.

[4 marks]

13

Turn over for the next question

4.10.3.2 Alloys as useful materials

Question 41

November 2020 | 8462/1F | Original Q5

0 5 This question is about aluminium.

0 5 . 1 Aluminium is a metal.

Draw **one** line from each property of aluminium to the correct reason for that property.

[2 marks]

Property	Reason
	Aluminium has delocalised electrons
Conducts electricity	Aluminium has layers of atoms which can slide
	Aluminium has strong metallic bonds
High melting point	Aluminium has weak intermolecular forces
	Aluminium has a random arrangement of atoms

0 5 . 2 Aluminium can be used to make alloys.

What is meant by an 'alloy'?

[1 mark]

4.10.3.2 Alloys as useful materials

Question 41 · continued

Aluminium is extracted from bauxite.

Bauxite is a mixture which contains aluminium oxide.

0 5 . 3 Bauxite contains between 15% and 25% aluminium.

Aluminium oxide always contains 53% aluminium.

How does this show that bauxite is a mixture and **not** a compound?

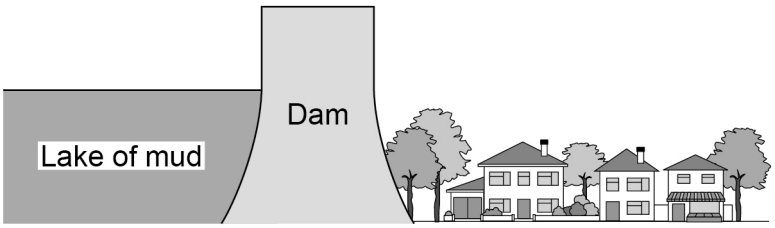
[1 mark]

0 5 . 4 The waste material from the bauxite is stored in lakes of mud.

The lakes of mud are held in place by dams.

Figure 6 shows one of these lakes.

Figure 6



Suggest **two** possible problems with storing the waste material in lakes of mud.

[2 marks]

1

2

4.10.3.2 Alloys as useful materials

Question 41 · continued November 2020 | 8462/1F | Original Q5

Aluminium is extracted by electrolysis.

The aluminium oxide is mixed with cryolite and melted.

The mixture is then electrolysed.

0 5 . 5 The formula of cryolite is Na_3AlF_6

Give the total number of atoms in the formula.

[1 mark]

Number of atoms = _____

0 5 . 6 What is the reason for adding cryolite to the aluminium oxide?

[1 mark]

Tick (✓) **one** box.

To increase the amount of aluminium extracted ☐

To lower the melting point of the mixture ☐

To reduce the amount of aluminium oxide needed ☐

4.10.3.2 Alloys as useful materials

Question 41 · continued

0 5 . 7 Complete the sentences.

Choose answers from the box.

[2 marks]

aluminium	**carbon**	**fluorine**
oxygen	**sodium**	

When the molten aluminium oxide and cryolite mixture is electrolysed the product at the positive electrode is _____.

This product reacts with the positive electrode because the positive electrode is made of _____.

0 5 . 8 A sample of bauxite contains 25% aluminium.

Calculate the maximum mass of aluminium that can be extracted from 300 000 kg of the sample of bauxite.

Give your answer in standard form.

[3 marks]

_____

_____

_____

_____

_____

Maximum mass (in standard form) = _____ kg

13

4.10.3.2 Alloys as useful materials

Question 42

November 2020 | 8462/2F | Original Q5

0 5 This question is about alloys.

Bronze and brass are both alloys which contain copper.

0 5 . 1 Bronze is an alloy of copper and one other metal.

What is the other metal in bronze?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Tin ☐

Zinc ☐

0 5 . 2 Give **one** use of brass.

[1 mark]

_____

_____

Question 5 continues on the next page

Question 42 · continued

Alloys of gold are used to make jewellery.

0 5 . 3 The proportion of gold in an alloy is measured in carats:

- pure gold is 24 carat
- 50% gold is 12 carat.

Table 3 shows information about two gold rings, **A** and **B**.

A and **B** contain only gold and silver.

Complete **Table 3**.

[2 marks]

Table 3

Gold ring	Carat	Mass of metal in grams	
		gold	silver
A		7	7
B	18	9	

0 5 . 4 Suggest **two** reasons why alloys of gold are used instead of pure gold to make jewellery.

[2 marks]

1 _____

_____

2 _____

_____

4.10.3.2 Alloys as useful materials

Question 42 · continued

Steels are alloys of iron.

0 5 . 5 Spoons are made of stainless steel.

Spoons:

- are washed after use
- must not wear away quickly.

Suggest **one** reason why stainless steel is suitable for making spoons.

[1 mark]

0 5 . 6 Steel horseshoes are shaped to fit the feet of horses.

Which type of steel is most easily shaped into horseshoes?

[1 mark]

Tick (✓) **one** box.

High carbon steel ☐

Low carbon steel ☐

Stainless steel ☐

8

4.10.3.2 Alloys as useful materials

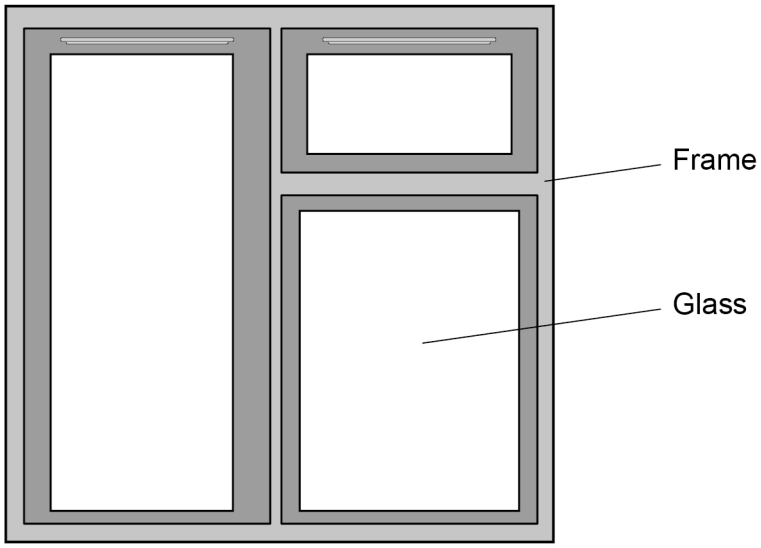
Question 43

November 2021 | 8462/2F | Original Q3

0 3 This question is about substances used to make windows and window frames.

Figure 2 shows a window.

Figure 2



0 3 . 1 Glass is made by heating sand with **two** other materials.

Which **two** other materials are used to make glass?

[2 marks]

Tick (✓) **two** boxes.

- Clay ☐
- Graphite ☐
- Limestone ☐
- Sodium carbonate ☐
- Sodium hydroxide ☐

4.10.3.2 Alloys as useful materials

Question 43 · continued

Window frames need to be:

- easy to install
- resistant to damage.

The polymers poly(chloroethene) and HDPE are used to make window frames.

Table 3 shows information about poly(chloroethene) and HDPE.

Table 3

Property	Poly(chloroethene)	HDPE
Density in g/cm^3	1.4	0.92
Relative strength	72	25

0 3 . 2 Suggest **one** advantage of using poly(chloroethene) compared with HDPE to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

Reason _____

_____

0 3 . 3 Suggest **one** advantage of using HDPE compared with poly(chloroethene) to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

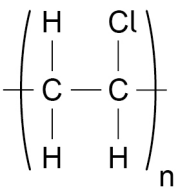
Reason _____

_____

Question 43 · continued

0 3 . 4 **Figure 3** shows the displayed structural formula of poly(chloroethene).

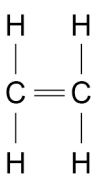
Figure 3

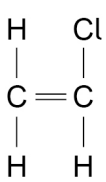


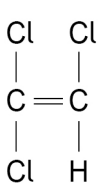
Which monomer is used to make poly(chloroethene)?

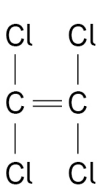
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

Question 43 · continued

0 3 . 5 Chlorine gas is used to produce poly(chloroethene).

Describe a test to identify chlorine gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 3 . 6 Wood can be used instead of polymers to make window frames.

- Polymers are unreactive.
- Polymers are produced from crude oil.
- Wood breaks down in wet conditions.
- Wood is produced from trees.

Suggest **one** advantage of using polymers and **one** advantage of using wood to make window frames.

[2 marks]

Advantage of polymers _____

_____

Advantage of wood _____

_____

Question 3 continues on the next page

4.10.3.2 Alloys as useful materials

Question 43 · continued

Window frames can also be made from an alloy of aluminium.

0 3 . 7 6.00 kg of the alloy is used to make a window frame.

Table 4 shows the mass of each element in 6.00 kg of the alloy.

Table 4

Element	Mass in kg
Aluminium	5.94
Magnesium	0.04
Silicon	0.02

Calculate the percentage of aluminium in 6.00 kg of the alloy.

[2 marks]

Percentage of aluminium = _____ %

0 3 . 8 Why is an alloy used instead of pure aluminium to make window frames?

[1 mark]

14

4.10.3.2 Alloys as useful materials

Question 44

June 2023 | 8462/1F | Original Q4

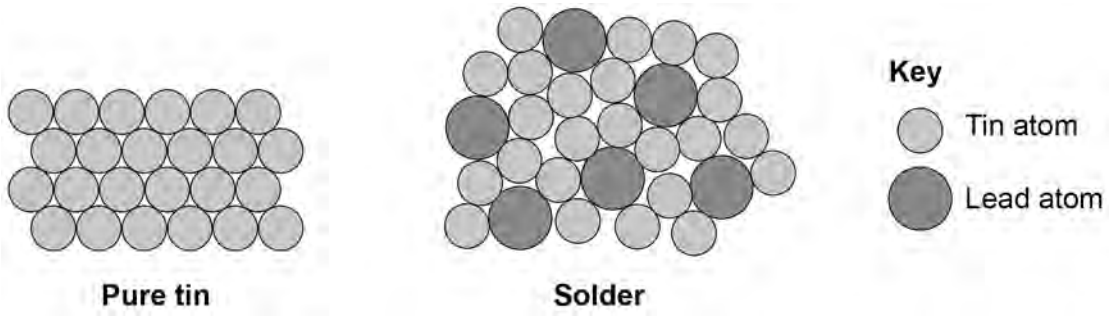
0 4 This question is about alloys.

Solders are alloys of tin and lead.

Different solders have different percentages of tin and lead.

Figure 4 shows the arrangement of atoms in pure tin and in a solder.

Figure 4



0 4 . 1 The solder in **Figure 4** has 6 lead atoms for every 24 tin atoms.

Determine the percentage of atoms that are lead atoms in the solder in **Figure 4**.

[3 marks]

Percentage of lead atoms = _____ %

0 4 . 2 Explain why solder is harder than pure tin.

Complete the sentences.

Use **Figure 4**.

[2 marks]

In solder the layers are distorted.

This is because the atoms of tin and lead have different _____.

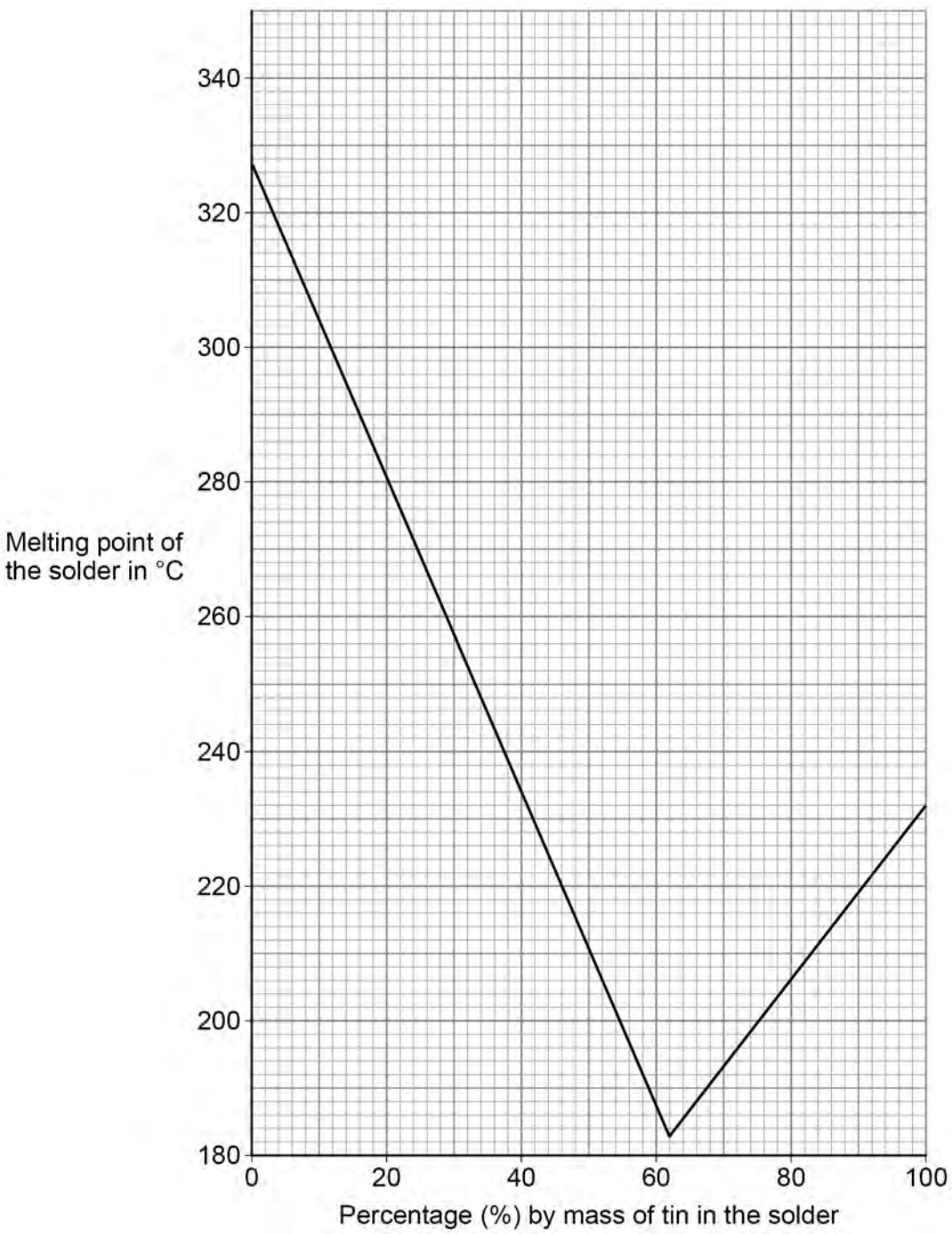
Therefore the layers cannot easily _____.

4.10.3.2 Alloys as useful materials

Question 44 · continued

Figure 5 shows how the melting point of the solder changes with the percentage by mass of tin in the solder.

Figure 5



4.10.3.2 Alloys as useful materials

Question 44 · continued

0 4 . 3 Describe what happens to the melting point of the solder as the percentage by mass of tin increases.

Use data from **Figure 5**.

[3 marks]

0 4 . 4 What is the melting point of pure tin?

Use **Figure 5**.

[1 mark]

Melting point of pure tin = _____ °C

0 4 . 5 What happens to the atoms in pure tin as the tin melts?

[1 mark]

Tick (✓) **one** box.

- The atoms gain energy and their arrangement becomes less ordered. ☐
- The atoms gain energy and their arrangement becomes more ordered. ☐
- The atoms lose energy and their arrangement becomes less ordered. ☐
- The atoms lose energy and their arrangement becomes more ordered. ☐

10

4.10.3.2 Alloys as useful materials

Question 45

June 2023 | 8462/2F | Original Q7

0 7 This question is about alloys.

Steels are alloys of iron.

0 7 . 1 Which non-metal element is in all steels?

[1 mark]

Tick (✓) **one** box.

- Carbon ☐
- Iodine ☐
- Sulfur ☐

0 7 . 2 Which **two** elements other than iron are in stainless steels?

[2 marks]

Tick (✓) **two** boxes.

- Chromium ☐
- Gold ☐
- Magnesium ☐
- Nickel ☐
- Zinc ☐

Question 7 continues on the next page

Question 45 · continued

0 7 . 3 Give **two** properties of stainless steels.

Choose answers from the box.

[2 marks]

brittle	**hard**	**low density**
resistant to corrosion	**soluble in water**	

Property 1 _____

Property 2 _____

Titanium is used in alloys.

Table 6 shows information about some alloys of titanium.

Table 6

Titanium alloy	Other metals in alloy	Strength	Used in
A	6.0% aluminium 4.0% vanadium	high	aircraft parts hip joint replacements
B	5.0% aluminium 2.5% tin	high	aircraft parts
C	3.0% aluminium 2.5% vanadium	medium	tennis rackets heart pacemakers

0 7 . 4 Calculate the mass of titanium in 5.0 kg of titanium alloy **C**.

Use **Table 6**.

[3 marks]

Mass = _____ kg

4.10.3.2 Alloys as useful materials

Question 45 · continued

June 2023 | 8462/2F | Original Q7

0 7 . 5 Suggest why alloy **A** and alloy **B** are used to make aircraft parts.

Use **Table 6**.

[1 mark]

0 7 . 6 Titanium alloys used for medical purposes must **not** be toxic.

Suggest why alloy **B** is **not** used for medical purposes.

Use **Table 6**.

[1 mark]

10

4.10.3.2 Alloys as useful materials

Question 46

June 2024 | 8462/2F | Original Q7

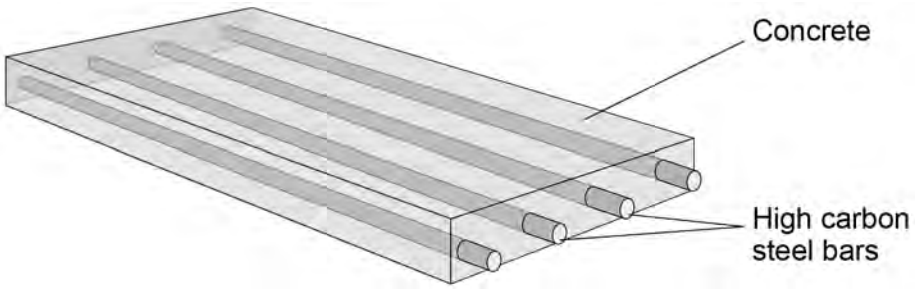
0 7 This question is about materials.

Pre-stressed concrete is a composite material.

The concrete is strengthened using high carbon steel bars.

Figure 8 shows the structure of a piece of pre-stressed concrete.

Figure 8



0 7 . 1 Which **two** words describe the high carbon steel bars?

[2 marks]

Tick (✓) **two** boxes.

- Alloy ☐
- Binder ☐
- Matrix ☐
- Ore ☐
- Reinforcement ☐

4.10.3.2 Alloys as useful materials

Question 46 · continued

Limestone is mainly calcium carbonate.

Limestone is a raw material used in the production of concrete.

0 7 . 2 In the first part of the production of concrete:

- air is heated by burning methane
- the hot air is used to heat limestone
- the limestone decomposes.

The equation for the decomposition of limestone is:

calcium carbonate → calcium oxide + carbon dioxide

Give **two** ways in which a greenhouse gas is released in this process.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 3 How could a sample of limestone be tested to show the presence of carbonate ions?

Complete the sentences.

Choose answers from the box.

[2 marks]

barium chloride	**hydrochloric acid**	**limewater**
sodium hydroxide		**universal indicator**

The substance added to the limestone is _____.

The gas produced is identified using _____.

Question 7 continues on the next page

4.10.3.2 Alloys as useful materials

Question 46 · continued

Table 4 gives some information about plain concrete and pre-stressed concrete.

Table 4

	Plain concrete	Pre-stressed concrete
Cost in £ per m^3	75	225
Density in kg per m^3	2300	2500
Strength in arbitrary units	600	3000

0 7 . 4 Explain why pre-stressed concrete rather than plain concrete is used to make bridges that carry heavy lorries.

Use **Table 4**.

[2 marks]

4.10.3.2 Alloys as useful materials

Question 46 · continued

June 2024 | 8462/2F | Original Q7

0 7 . 5 **Figure 9** shows a garden path made of plain concrete slabs.

Figure 9



Suggest **two** reasons why plain concrete rather than pre-stressed concrete is used to make slabs for garden paths.

Use **Table 4**.

[2 marks]

1 _____

_____

2 _____

_____

10

4.10.3.2 Alloys as useful materials

Question 47

June 2025 | 8462/2F | Original Q3

0 3 Cement, concrete and steel are building materials.

Cement contains calcium oxide.

Calcium oxide reacts with water to produce calcium hydroxide.

The equation for the reaction is:

calcium oxide + water ⇌ calcium hydroxide

0 3 . 1 How does the equation show that this reaction is reversible?

[1 mark]

0 3 . 2 The forward reaction is exothermic.

What type of reaction is the reverse reaction?

[1 mark]

0 3 . 3 When excess water is added to 20 g of calcium oxide, 23 kJ of energy is released.

Calculate the energy released when excess water is added to 4 g of calcium oxide.

[2 marks]

Energy released = _____ kJ

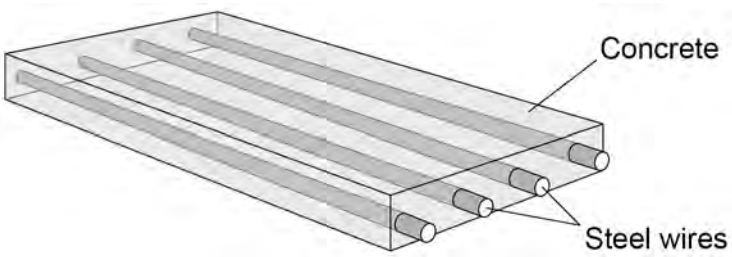
4.10.3.2 Alloys as useful materials

Question 47 · continued

Pre-stressed concrete contains steel wires within the concrete.

Figure 2 shows the structure of a piece of pre-stressed concrete.

Figure 2



0 3 . 4 Pre-stressed concrete is a composite.

Draw **one** line from each component of a composite to a material in pre-stressed concrete.

[2 marks]

Component of composite	Material in pre-stressed concrete
	Concrete
Binder	
	Pre-stressed concrete
Reinforcement	
	Steel wires

0 3 . 5 Which metal do **all** steels contain?

[1 mark]

_____

4.10.3.2 Alloys as useful materials

Question 47 · continued

0 3 . 6 Bricks are also building materials.

Bricks are ceramics.

Which material is used to make bricks?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Clay ☐

Poly(ethene) ☐

8

Turn over for the next question

4.10.3.2 Alloys as useful materials

Question 48

June 2025 | 8462/2F | Original Q7

0 7 This question is about gold.

18 carat gold is an alloy containing 75% by mass of gold.

0 7 . 1 Calculate the mass of gold in a 4 g jewellery ring made from 18 carat gold.

[2 marks]

Mass = _____ g

0 7 . 2 What is the simplest whole-number ratio of the mass of gold : mass of other metals in 18 carat gold?

[1 mark]

Tick (✓) **one** box.

1 : 3 ☐ 3 : 1 ☐ 6 : 18 ☐ 18 : 6 ☐

0 7 . 3 What other **two** metals may also be present in 18 carat gold?

[2 marks]

Tick (✓) **two** boxes.

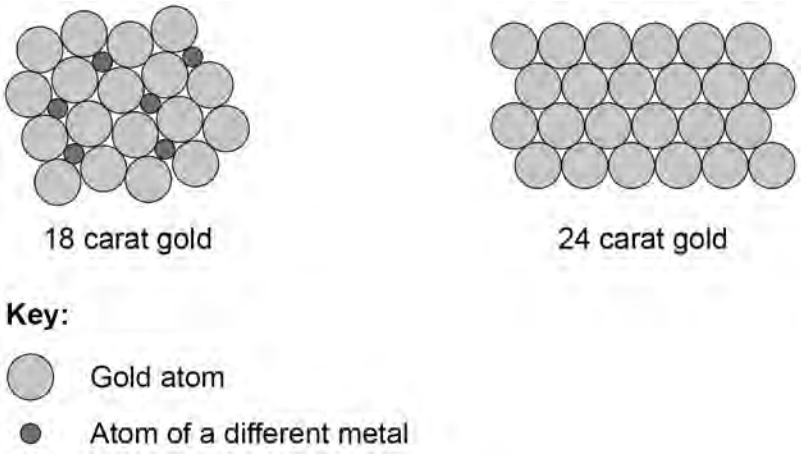
- Copper ☐
- Magnesium ☐
- Potassium ☐
- Silver ☐
- Sodium ☐

4.10.3.2 Alloys as useful materials

Question 48 · continued

0 7 . 4 **Figure 6** represents the structure of 18 carat gold and of 24 carat gold.

Figure 6



Explain why 18 carat gold is harder than 24 carat gold.

[3 marks]

0 7 . 5 Gold is used to make jewellery.

Give **one** reason why iron is **not** used to make jewellery.

[1 mark]

9