AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.10.3 USING MATERIALS

SCORE	PERCENTAGE
/271	%

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Q1.

Polymers are used to make fabrics.

Table 1 shows some properties of two polymers.

Table 1

Property	Polymer J	Polymer K
Density in g/cm^3	0.9	1.4
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

(a) Polymer fabrics are used to make firefighter uniforms.

Complete **Table 2** by deciding for each property whether polymer J or polymer K is best for firefighter uniforms.

Use **Table 1**.

Density has been completed for you.

Tick **three** boxes.

Table 2

Property	Polymer J	Polymer K
Density in g/cm^3	✓	
Melting point in °C		
Flame resistance		
Water absorption		

(2)

(b) A firefighter uniform made from polymer **J** has a mass of 6.0 kg

Calculate the mass of a uniform of the same size made from polymer **K**.

Use **Table 1** and the equation:

$$\text{mass of uniform made from polymer } \mathbf{K} = \frac{\text{density of polymer } \mathbf{K}}{\text{density of polymer } \mathbf{J}} \times 6.0$$

_____

_____

_____

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Mass of uniform made from polymer **K** = _____ kg

(2)

(c) Polymers **J** and **K** are both thermosoftening polymers.

Polymer **L** is a thermosetting polymer.

Why would polymer **L** be better than polymers **J** and **K** for firefighter uniforms?

Tick **one** box.

Polymer **L** burns easily ☐

Polymer **L** does not biodegrade ☐

Polymer **L** will not melt ☐

(1)

Polymers **J** and **K** are made from crude oil.

In the past, firefighter uniforms were made from wool.

Wool is obtained from sheep.

(d) Why are many fabrics made from polymers instead of wool?

Tick **one** box.

Polymers are man-made ☐

Polymers are more hard-wearing ☐

Wool is more easily available ☐

Wool is more flame resistant ☐

(1)

(e) Why is wool more sustainable than polymers **J** and **K** for making firefighter uniforms?

_____

_____

_____

_____

(2)

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(Total 8 marks)

Q2.

This question is about alloys of copper.

(a) Complete the sentence.

Choose the answer from the box.

aluminium	**iron**	**magnesium**	**tin**

Bronze is an alloy of copper and _____.

(1)

Brass is an alloy of copper and zinc.

The table shows the percentage by mass of copper and zinc in two types of brass.

Type of brass	**Percentage (%) by mass**	
	Copper	**Zinc**
Red brass	90	10
Yellow brass	**X**	30

(b) Calculate value **X** in the table above.

_____

Percentage by mass **X** = _____ %

(1)

(c) Calculate the mass of copper in 1100 g of red brass.

_____

_____

Mass = _____ g

(2)

(d) What is meant by an alloy?

_____

_____

(1)

(e) Brass contains layers of atoms which can slide over each other.

Explain why red brass is softer than yellow brass.

Use the table above and your own knowledge.

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_____

_____

_____

_____

(2)

(f) Some musical instruments are made of brass.

Parts of these instruments can be gold plated.

What is the carat number of pure gold?

Tick (✔) **one** box.

9 ☐ **18** ☐ **22** ☐ **24** ☐

(1)

(Total 8 marks)

Q3.

This question is about mixtures and analysis.

(a) Which **two** substances are mixtures?

Tick **two** boxes.

Air	☐
Carbon dioxide	☐
Graphite	☐
Sodium Chloride	☐
Steel	☐

(2)

(b) Draw **one** line from each context to the correct meaning.

Context	Meaning
	A substance that has had nothing added to it
Pure substance in chemistry	A single element or a single compound

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	A substance containing only atoms which have different numbers of protons
Pure substance in everyday life	A substance that can be separated by filtration
	A useful product made by mixing substances

(2)

(c) What is the test for chlorine gas?

Tick **one** box.

A glowing splint relights	☐
A lighted splint gives a pop	☐
Damp litmus paper turns white	☐
Limewater turns milky	☐

(1)

(d) A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

Tick **one** box.

Calcium	☐
Copper(II)	☐
Iron(II)	☐
Iron(III)	☐

(1)

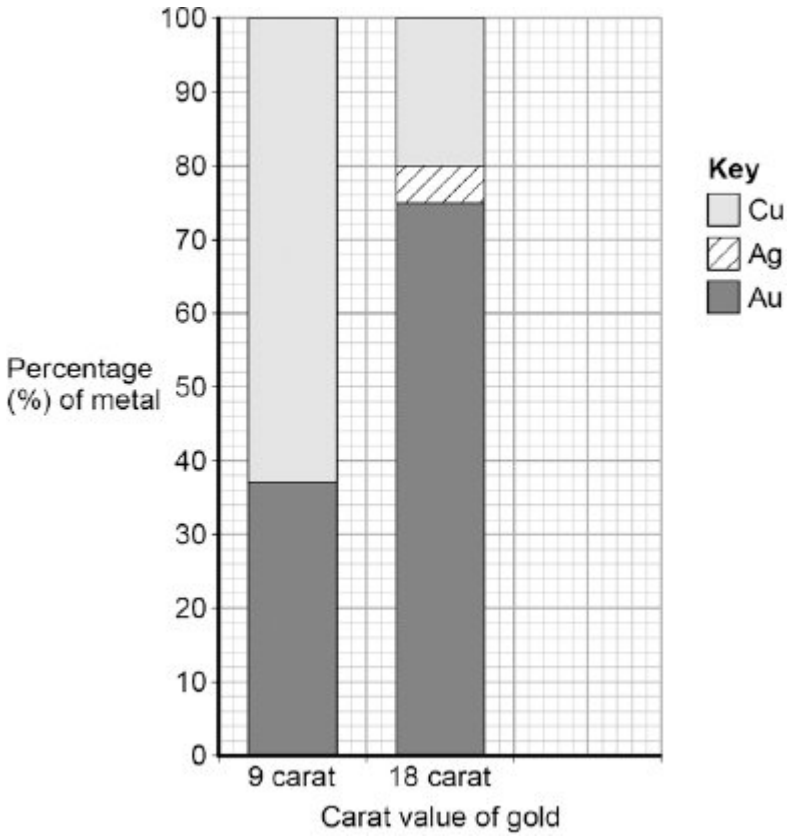
(Total 6 marks)

Q4.

Gold is mixed with other metals to make jewellery.

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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)

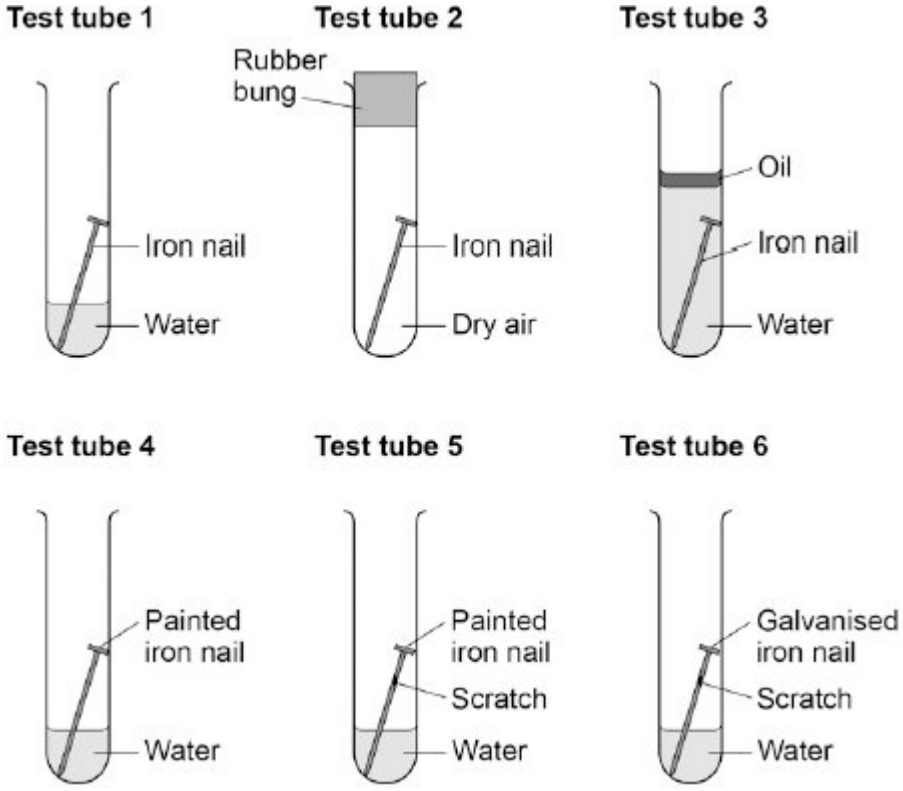
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Q5.

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 ☐

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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)

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

Complete the word equation for the reaction.

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

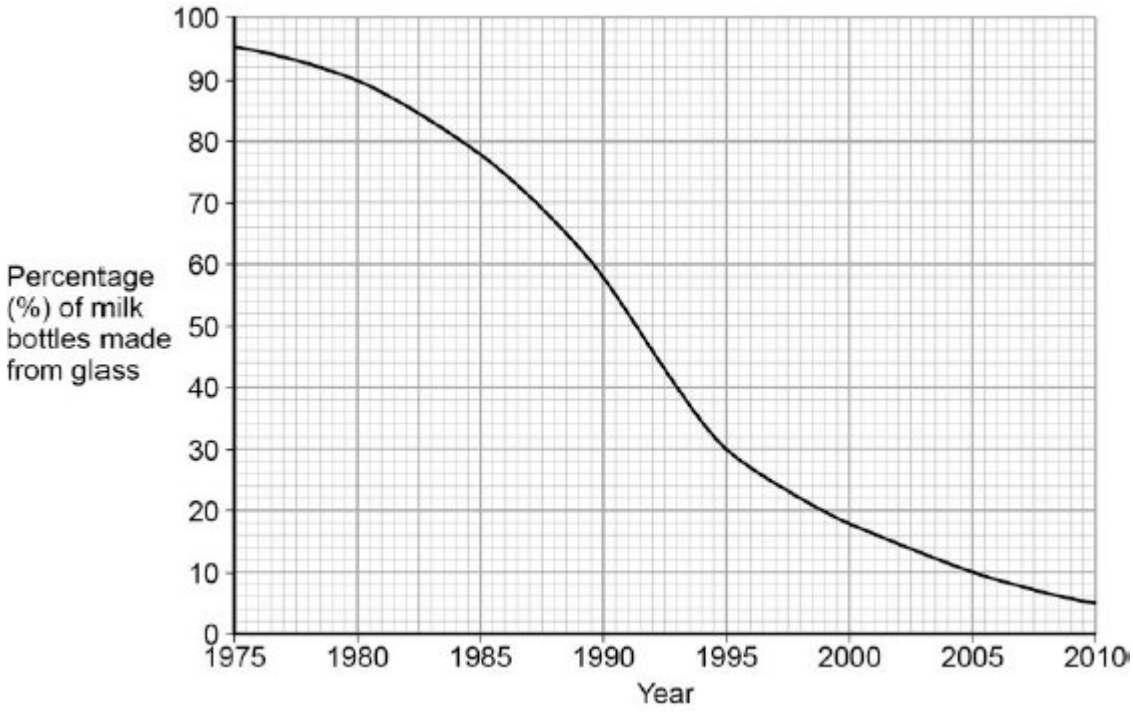
(2)

(Total 13 marks)

Q6.

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	1600 °C	850 °C

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process		
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)

Q7.

This question is about substances containing carbon atoms.

(a) Diamond is made of carbon atoms.

(i) Diamond is used for tips of drills.

Figure 1 shows a drill.

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Figure 1



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Give **one** reason why diamond is used for tips of drills.

_____

_____

(1)

(ii) Diamond nanoparticles can be made.

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

hundred	**million**	**thousand**

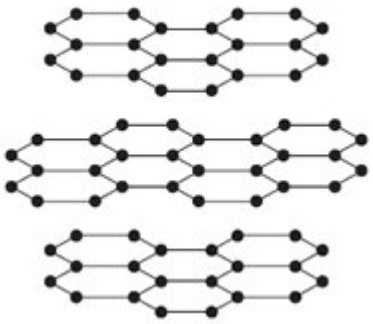
Nanoparticles contain a few _____ atoms.

(1)

(b) Graphite is made of carbon atoms.

Figure 2 shows the structure of graphite.

Figure 2



(i) What type of bonding does graphite have?

Tick (✔) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

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(1)

(ii) How many carbon atoms does each carbon atom bond to in graphite?

Tick (✔) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

(1)

(iii) What is a property of graphite?

Tick (✔) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

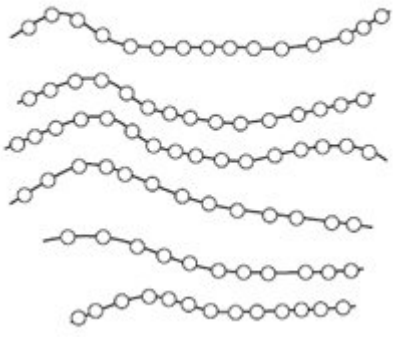
(1)

(c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 3 shows the structure of a thermosoftening polymer.

Figure 3



(i) Complete the sentence.

Between the polymer chains in a thermosoftening polymer there are no _____ .

(1)

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(ii) Use the correct answer from the box to complete the sentence.

condense	dissolve	melt

Heating would cause a thermosoftening polymer to

_____ .

(1)

(iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction.
Suggest **two** conditions that could be changed.

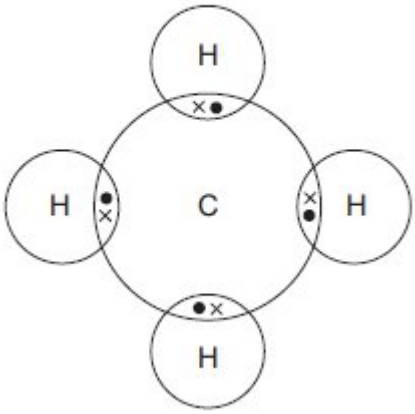
1. _____

2. _____

(2)

(d) **Figure 4** shows how the atoms are bonded in methane.

Figure 4



(i) What is the formula for methane?

Tick (✔) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

(1)

(ii) Methane has a low boiling point.

What does methane consist of?

Tick (✔) **one** box.

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Charged ions ☐

A giant lattice ☐

Small molecules ☐

(1)

(Total 11 marks)

Q8.

This question is about the properties and uses of materials.

Use your knowledge of structure and bonding to answer the questions.

(a) Explain how copper conducts electricity.

_____

_____

_____

_____

_____

(2)

(b) Explain why diamond is hard.

_____

_____

_____

_____

_____

(2)

(c) Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

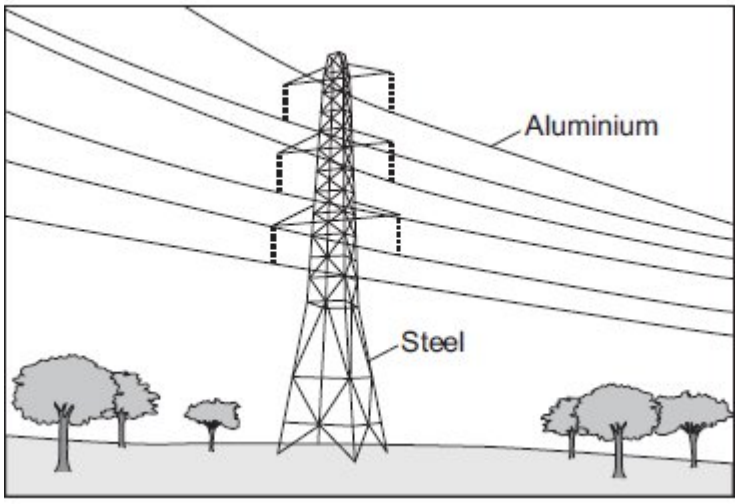
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Q9.

This question is about metals.

Figure 1 shows the metals used to make pylons and the wires of overhead cables.

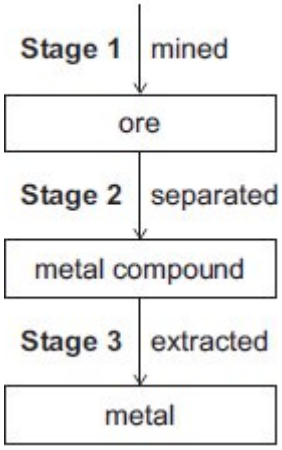
Figure 1



(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

Figure 2



Explain why **Stage 2** needs to be done.

_____

_____

_____

_____

(2)

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

(i) Cast iron is not suitable for the manufacture of pylons.

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Give **one** reason why.

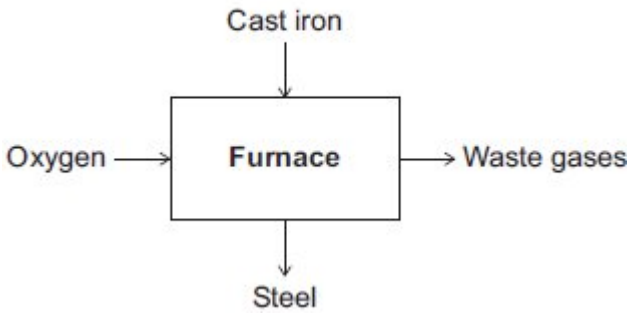
_____

_____

(1)

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

Figure 3



Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

_____

_____

_____

_____

(2)

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

_____

_____

(1)

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

_____

_____

_____

_____

(2)

(iii) Copper can be extracted from solutions of copper salts by adding iron.

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Explain why.

_____

_____

_____

_____

(2)

(Total 10 marks)

Q10.

This question is about salts.

(a) Salt (sodium chloride) is added to many types of food.

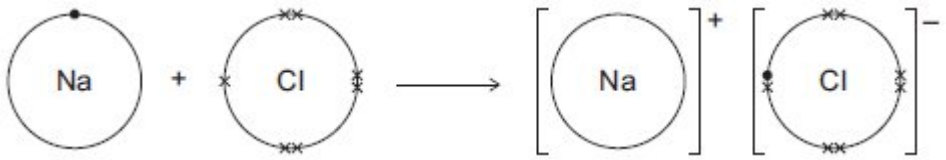
Sodium chloride is produced by reacting sodium with chlorine.

sodium + chlorine ⟶ sodium chloride

The diagram shows what happens to atoms of sodium and chlorine in this reaction.

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

Only the outer electrons are shown.



Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

_____

_____

_____

_____

_____

_____

(3)

(b) Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

(i) Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

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Tick (✓) **one** box.

Have no overall electric charge ☐

Have high boiling points ☐

Have giant covalent structures ☐

(1)

(ii) Which one of the following questions cannot be answered by science alone?

Tick (✓) **one** box.

How much sodium chloride is in food? ☐

What harm does a lack of iodine do? ☐

Should iodine be added to salt in food? ☐

Give **one** reason why this question cannot be answered by science alone.

_____

_____

(2)

(c) A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

(i) Name the acid used.

_____

(1)

(ii) Use the correct answer from the box to complete the sentence.

an acid	**an alkali**	**a salt**

Ammonia solution (ammonium hydroxide) is _____ .

(1)

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(iii) The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

The solution added is an _____ .

(1)

(d) Farmers buy solid ammonium nitrate in poly(ethene) sacks.

(i) How is solid ammonium nitrate made from a solution of ammonium nitrate?

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

(1)

(ii) Why do farmers use ammonium nitrate on their fields?

_____

_____

(1)

(iii) The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

_____

_____

(1)

(Total 12 marks)

Q11.

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.

_____

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_____

_____

_____

_____

_____

_____

_____

(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).

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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)

Q12.

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.

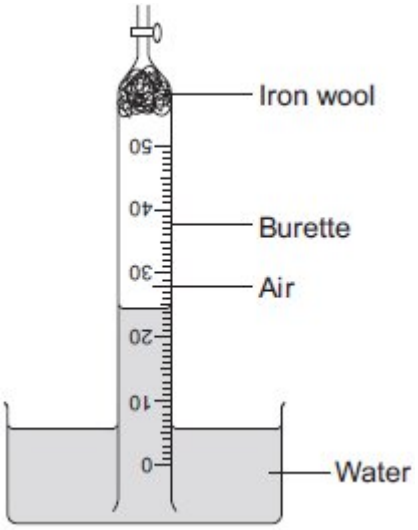
_____

(1)

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

Figure 1

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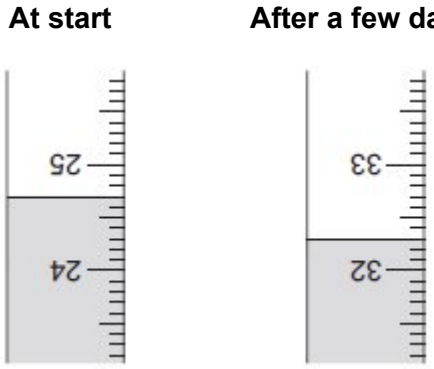


The student left the apparatus for a few days.

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:

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

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

Explain why.

_____

_____

_____

_____

_____

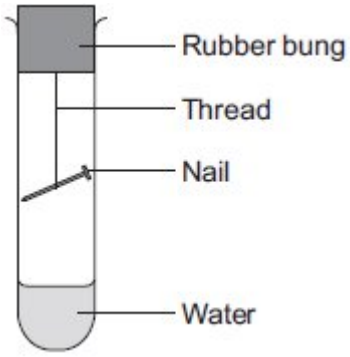
(2)

(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

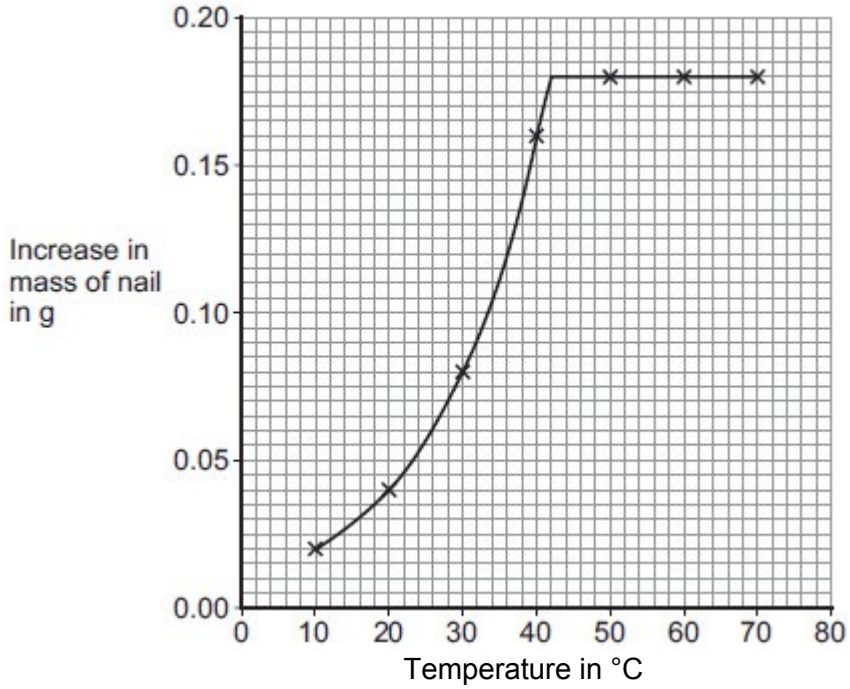


The student repeated the experiment at different temperatures using a new, identical, nail each time.

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

Figure 4

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(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.

_____

_____

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_____

_____

_____

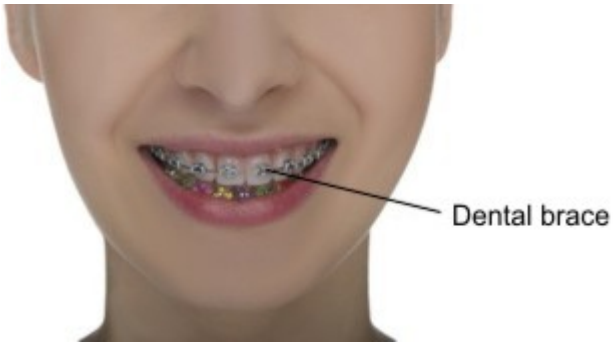
_____

(2)

(Total 12 marks)

Q13.

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



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

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

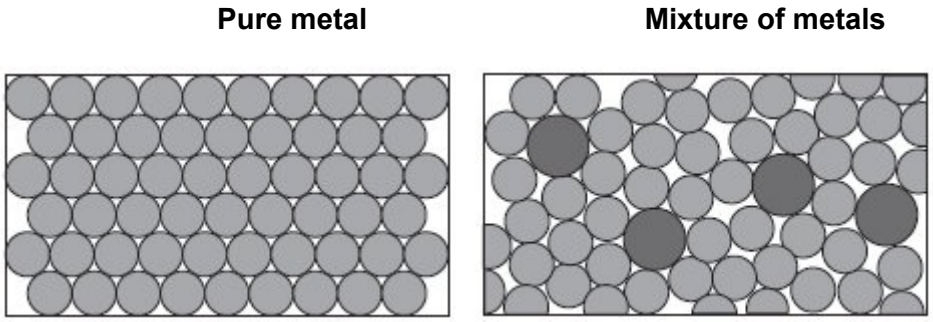
Nitinol is a shape memory

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.

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_____

_____

_____

_____

(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.

_____

_____

_____

_____

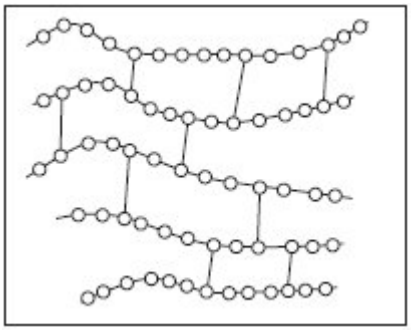
(2)

(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?

_____

_____

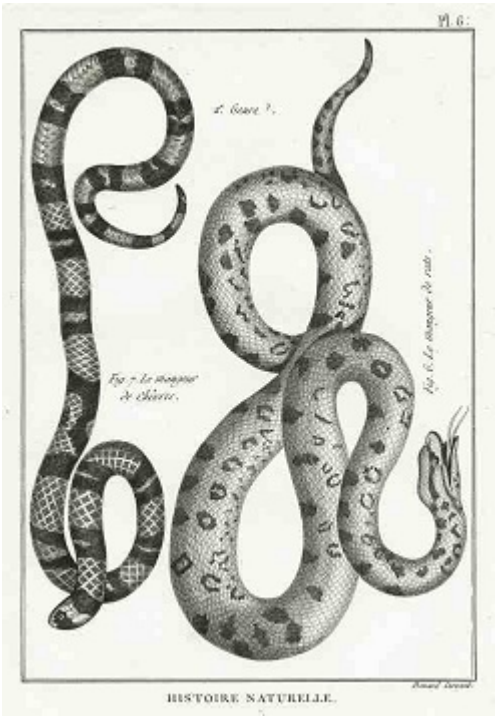
(1)

(Total 6 marks)

Q14.

Printed pictures can be made using etchings.

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

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

(i) A mixture of two metals is called _____ .

(1)

(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)

(b) Iron chloride has the formula $FeCl_3$

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

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

_____

_____

_____

Relative formula mass (M_r) of iron chloride = _____

(2)

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

_____

_____

_____

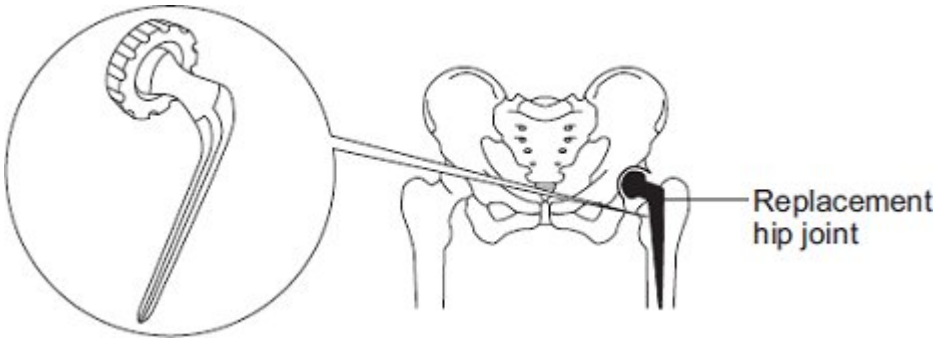
Percentage of iron in iron chloride = _____%

(2)

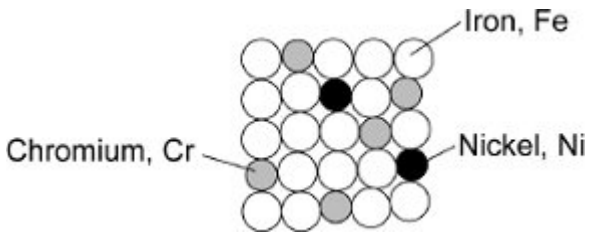
(Total 6 marks)

Q15.

The hip joint sometimes has to be replaced.
Early replacement hip joints were made from stainless steel.



Stainless steel is an alloy of iron, chromium and nickel.
The diagram below represents the particles in stainless steel.



Paticle diagram of stainless steal

(a) Use the diagram to complete the percentages of metals in this stainless steel.

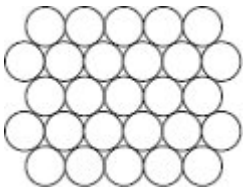
The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	
Nickel, Ni	

(2)

(b) Pure iron is a soft, metallic *element*.

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(i) Why is iron described as an *element*?

_____

_____

(1)

(ii) Pure iron would **not** be suitable for a replacement hip joint.

Suggest why.

_____

_____

(1)

(iii) The three metals in stainless steel have different sized atoms.
Stainless steel is harder than pure iron.

Explain why.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q16.

(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?

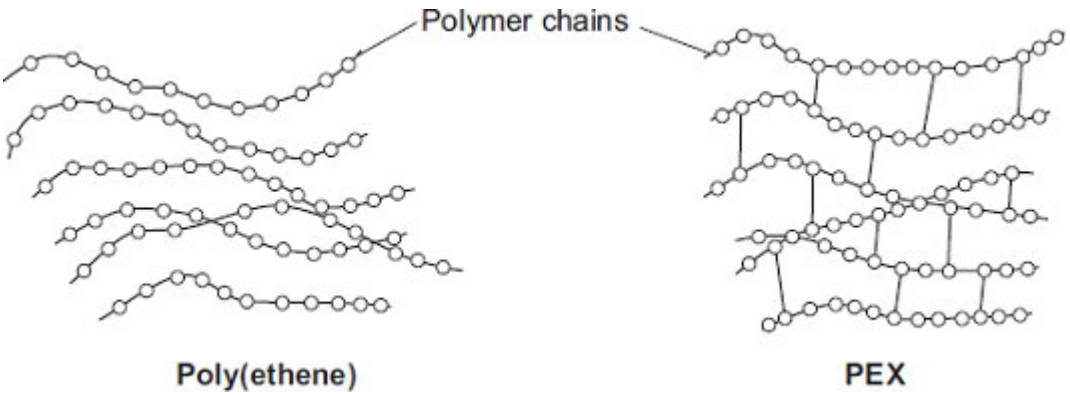
_____

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_____

(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

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- 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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q17.

Poly(ethene) is a polymer with many uses.

(a) Poly(ethene) is not biodegradable.

Give **one** problem caused by waste poly(ethene).

_____

(1)

(b) Many molecules of ethene are combined to make poly(ethene). Ethene is an alkene.

(i) Complete the sentence about the colour change in the test for alkenes.

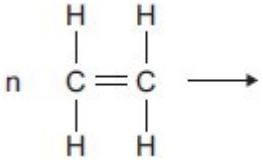
Alkenes turn bromine water from _____ to

_____ .

(2)

(ii) Complete the equation below to show the formation of poly(ethene).

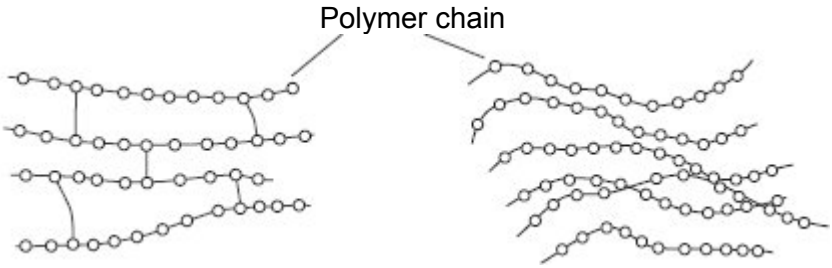
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(3)

(c) Poly(ethene) is a thermosoftening polymer that melts when heated.

The diagrams show a thermosetting polymer and a thermosoftening polymer.



Thermosetting polymer **Thermosoftening polymer**

The thermosetting polymer does **not** melt when heated.

Use the diagrams and your knowledge of structure and bonding to explain why.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q18.

Oil rigs are used to drill for crude oil.

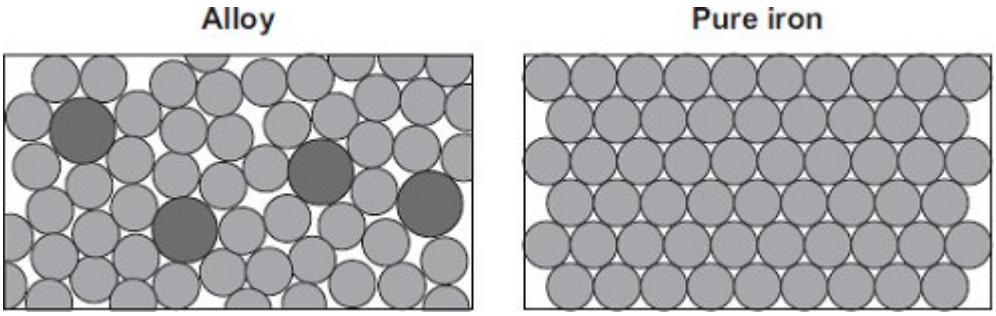
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© Digital Vision/Photodisc

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

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



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

_____

_____

_____

_____

(2)

(b) Drill heads contain diamonds.

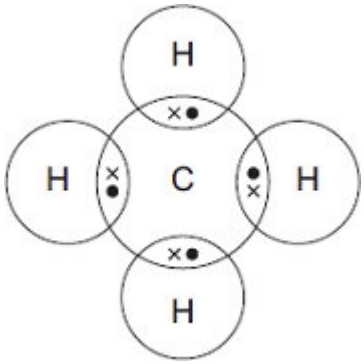
Tick (✓) **two** reasons why diamonds are hard.

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

(2)

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(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.



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

Methane is

a compound.
an element.
a mixture.

(1)

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

The formula of methane is

C_4H_4
C_4H
CH_4

(1)

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

_____

(1)

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

_____

_____

_____

_____

(2)

(Total 9 marks)

Q19.

Oil rigs are used to drill for crude oil.

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(a) Drill heads are made from steel. Steel is an alloy.

Explain why alloys are harder than pure metals.

(3)

(b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

(4)

(c) Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

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_____

_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

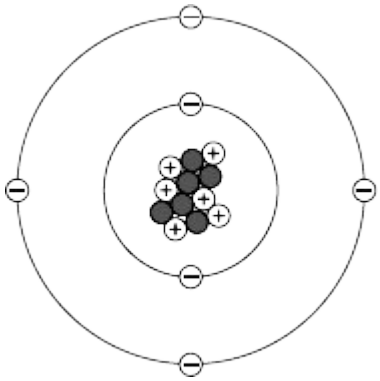
Q20.

The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

(a) Diamond is a form of carbon. The diagram represents a carbon atom.



Complete the table to show the name and charge of each type of particle in the carbon atom.

Name of particle	Charge
proton	
neutron	0
	-1

(2)

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(b) Use the Chemistry Data Sheet to help you to answer these questions.

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

Gold and carbon are

- compounds.
- elements.
- mixtures.

(1)

(ii) Complete the sentence.

Gold and carbon have different properties because gold is a metal and carbon is a _____

(1)

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

Pure gold is not used to make the ring because pure gold is too

- hard.
- reactive.
- soft.

The gold ring is made by mixing pure gold with other metals to form

- a compound.
- an atom.
- an alloy.

(2)

(d) The data in the table shows some information about the three metals in the gold ring.

Name of metal	Atomic number	Percentage (%) of metal
gold	79	
silver	47	16
copper	29	9

Draw **one** line from each question to its correct answer.

Question	Answer
	29

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What is the percentage of gold in this ring?	61
How many electrons are there in a copper atom?	75
How many neutrons are in an atom of silver with a mass number of 108?	79

(3)

(Total 9 marks)

Q21.

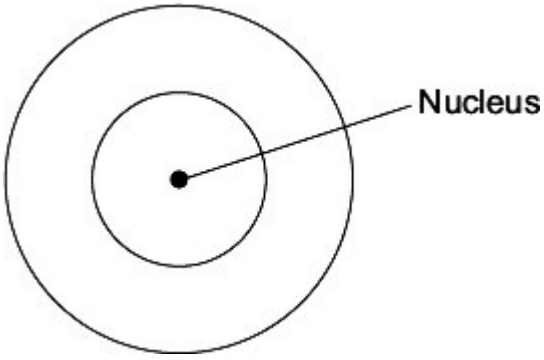
The picture shows a diamond ring.



Photograph supplied by Comstock/Thinkstock

(a) Diamond is a form of carbon. A carbon atom has six electrons.

Draw the electronic structure of a carbon atom.



(1)

(b) A gold atom has an atomic number of 79 and a mass number of 197.

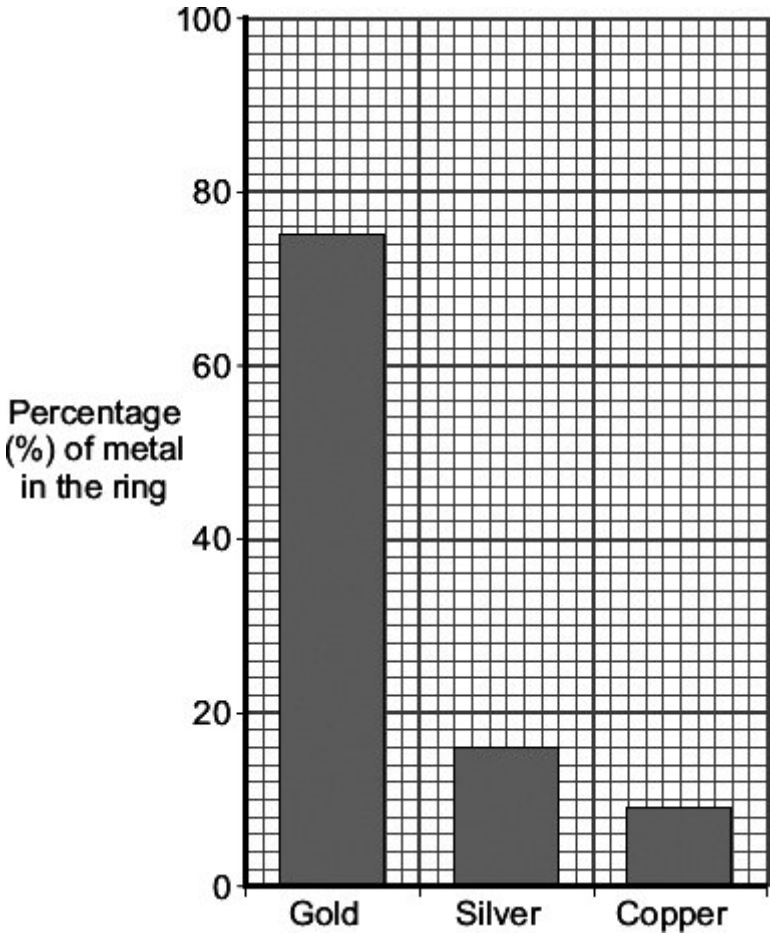
Complete the table to show the name and number of each sub-atomic particle in this gold atom.

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Name	Number
Proton	79
Electron	_____
_____	_____

(3)

(c) The bar chart shows the composition of this gold ring.



(i) Give the percentage of the other two metals in this gold ring.

Silver is _____ % and copper is _____ %

(1)

(ii) This gold ring is not made from 100% gold.

Give **two** reasons why.

1. _____

_____

_____

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2. _____

_____

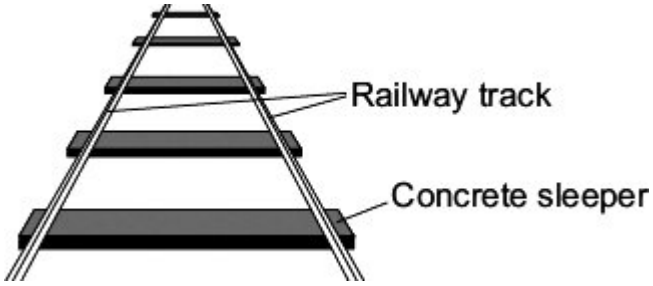
_____

(2)

(Total 7 marks)

Q22.

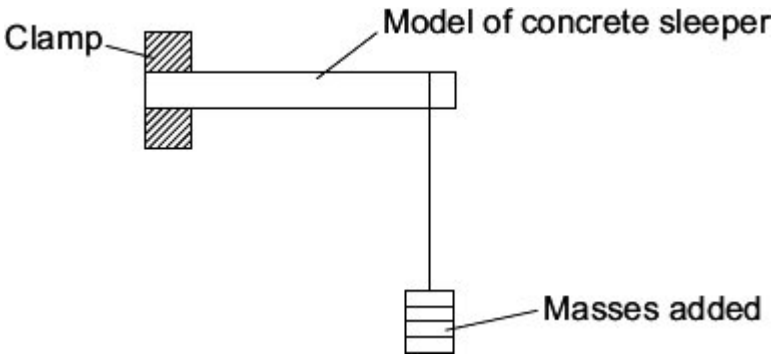
In the UK, railway sleepers are often made from concrete.



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	

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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?

_____

_____

_____

_____

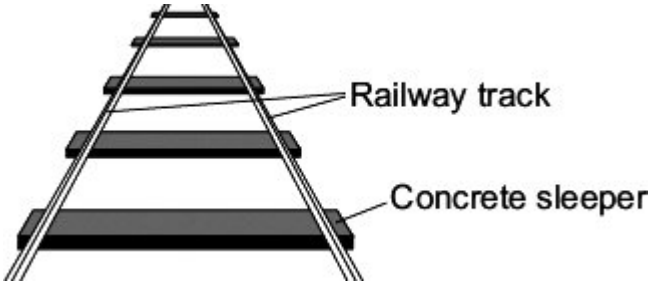
(2)

(Total 7 marks)

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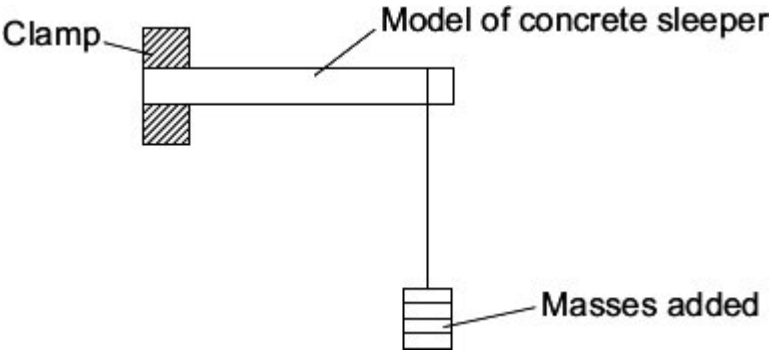
Q23.

In the UK, railway sleepers were made from wood.
They are now 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**	**Test 4**	**Mean**
10	70	20	1.2	1.1	1.3	1.2	1.2
20	60	20	3.0	2.6	2.5	2.4	
30	50	20	3.5	3.3	3.3	3.3	3.3
40	40	20	3.9	3.8	4.0	3.3	3.9
50	30	20	4.2	4.5	4.2	4.3	4.3

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

_____

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_____

Mean = _____ kg

(2)

(b) State **one** conclusion that the scientist could make from these results.

_____

_____

_____

(1)

(c) The scientist sent the results in a report to a company that makes full-size concrete railway sleepers.

(i) Suggest **two** other factors that the company should take into consideration before deciding which mixture to use to make a full-size concrete railway sleeper.

_____

_____

_____

_____

(2)

(ii) The scientist's report claimed that using concrete sleepers instead of wooden sleepers would have less environmental impact.
Do you agree with the scientist's claim?
Use your knowledge and understanding to justify your answer.
Remember to compare using concrete with using wood for the sleepers.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

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Q24.

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?

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_____

(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

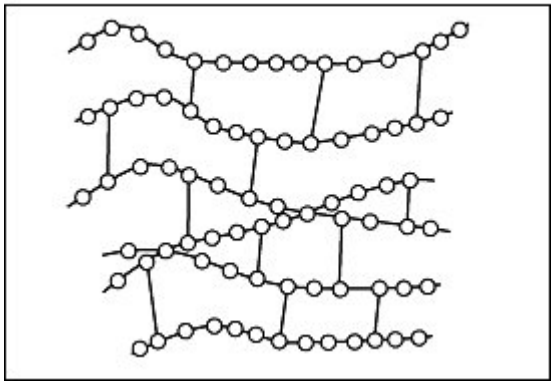
dissolve.
melt.
solidify.

(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?

_____

_____

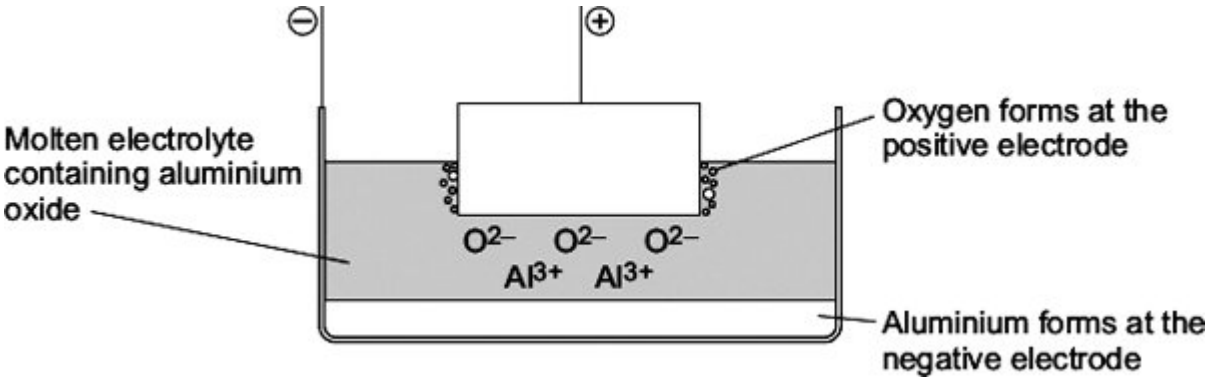
(1)

(Total 8 marks)

Q25.

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

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

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

Draw a ring around the correct answer.

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

(1)

(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)

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

Explain why.

_____

_____

_____

_____

(2)

(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)

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(iii) The positive electrode gets smaller.

Suggest why.

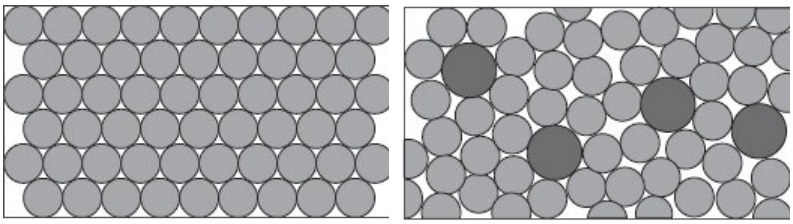
_____

_____

(1)

(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)

(Total 8 marks)

Q26.

Iron is extracted from its ore.

(a) Iron ore is quarried.

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Photograph supplied by Stockbyte/Thinkstock

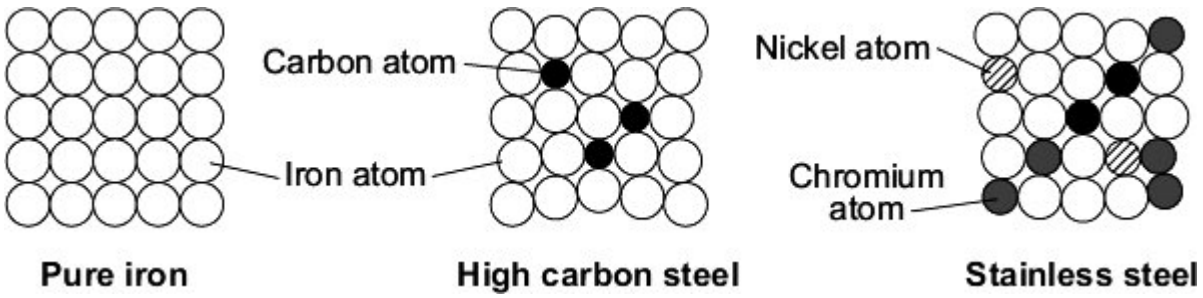
Quarrying iron ore has impacts that cause environmental problems.

Tick (✓) **two** impacts of quarrying that cause environmental problems.

Impact of quarrying	Tick (✓)
puts off tourists	
causes dust pollution	
increases jobs	
increases traffic	

(2)

(b) The diagrams represent the atoms in iron and the atoms in two alloys of iron.



Use the diagrams to help you to answer these questions.

(i) Complete the sentence.

Pure iron does **not** have many uses because _____

_____

(1)

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(ii) Stainless steel is more expensive than pure iron.

Suggest why.

_____

_____

(1)

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

(i) Pure iron is

a compound.
an element.
a mixture.

(1)

(ii) High carbon steel is used for a drill bit because it is

brittle.
easily bent.
hard.

(1)

(iii) Stainless steel is used to make cutlery because it

contains three different atoms.
melts at a very high temperature.
is resistant to corrosion.

(1)

(Total 7 marks)

Q27.

Steels are used to make cars, bridges and knives.
The main element in steel is iron.

(a) Iron is extracted from an *ore* that contains about 60% iron oxide, Fe_2O_3

(i) What is the meaning of *ore*?

_____

_____

(1)

(ii) In a blast furnace, iron oxide reacts with carbon monoxide to produce iron.
The word equation for this reaction is:

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iron oxide + carbon monoxide → iron + carbon dioxide

Complete and balance the chemical equation for this reaction.

Fe_2O_3 + ____ CO → _____ + _____

(2)

(iii) Name the type of reaction that produces a metal from its metal oxide.

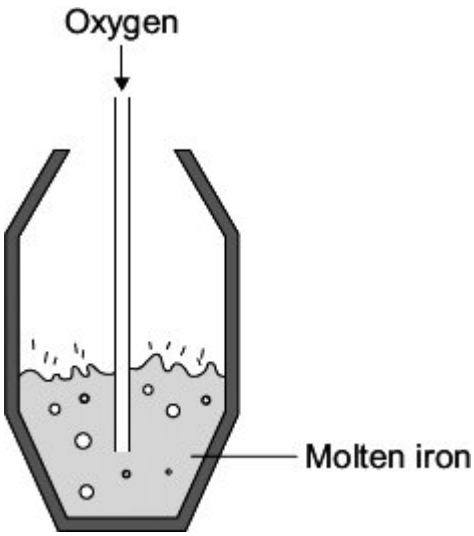
_____

(1)

(b) Steels are produced from molten iron in two stages:

Stage 1 blowing oxygen into molten iron from the blast furnace.

Stage 2 adding other metals to make different steels.



(i) In **Stage 1**, suggest how the oxygen removes most of the carbon from the molten iron.

_____

_____

_____

_____

(2)

(ii) **Stage 2** produces different steels.

Suggest why different steels are needed.

_____

_____

(1)

(c) Old 5p and 10p coins in the UK were made from cupro-nickel.
Cupro-nickel is 75% copper and 25% nickel.

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New 5p and 10p coins in the UK are now made from nickel-plated steel and not from cupro-nickel.

Explain why.

_____

_____

_____

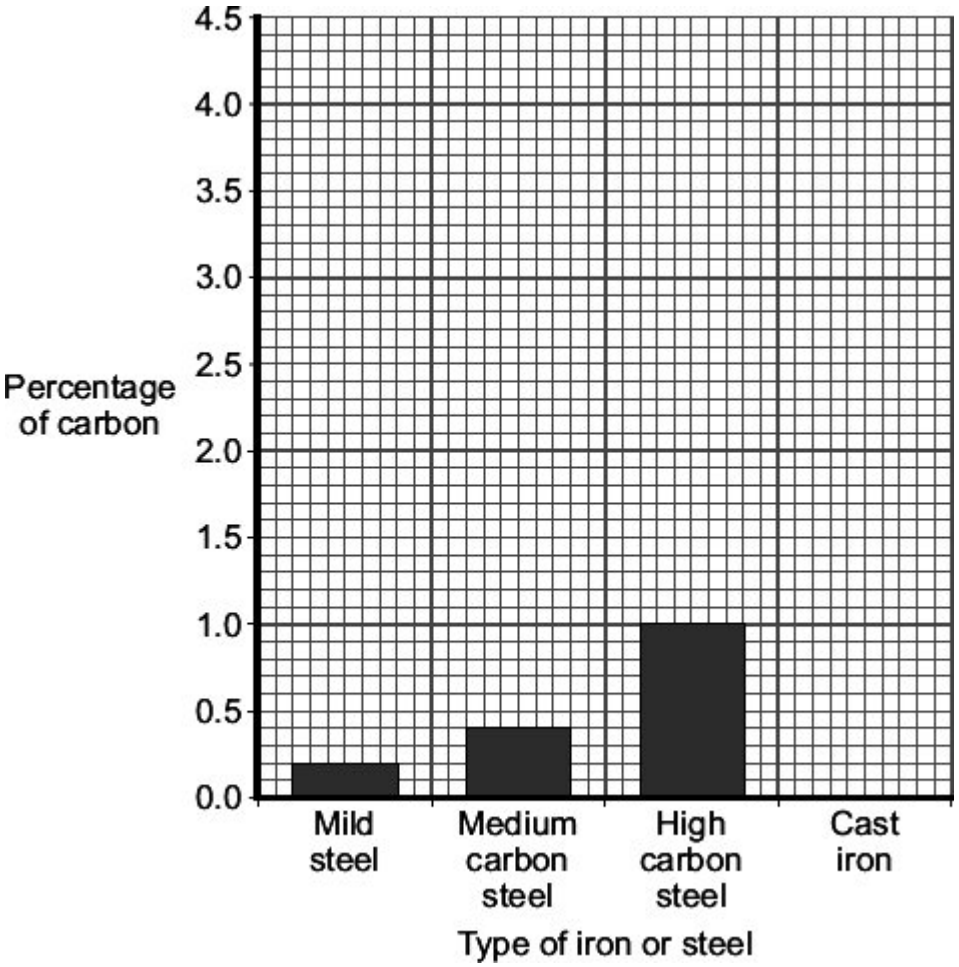
_____

(2)

(Total 9 marks)

Q28.

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



(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.

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(1)

(b) Cast iron contains 4% carbon.

Draw the bar for cast iron on the chart.

(1)

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

Use the bar chart to suggest why.

_____

_____

(1)

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

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

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

(1)

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

_____

(1)

(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)

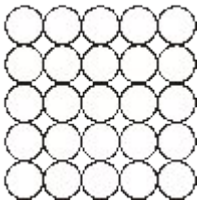
(Total 6 marks)

Q29.

Iron is the main structural metal used in the world.

(a) The diagram represents the particles in iron, Fe.

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

Iron is described as an element because all the

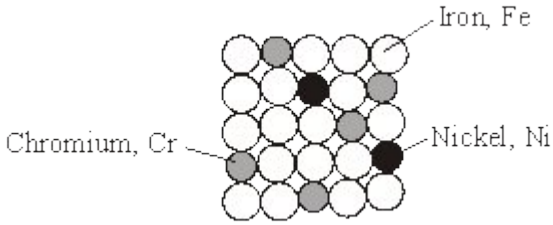
atoms
compounds
metals

are the same.

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.



Use the correct words from the box to complete the sentences about alloys.

metal	**mixture**	**molecule**	**polymer**	**smart**	**structure**

Stainless steel is an alloy because it is a _____ of iron, chromium and nickel.

An alloy is made up of more than one type of _____ .

Stainless steel alloys are harder than iron because the different sized atoms added change the _____ .

An alloy that can return to its original shape after being deformed is called a _____ alloy.

(4)

(c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

(i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1. _____

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_____

2. _____

_____

(2)

(ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

_____

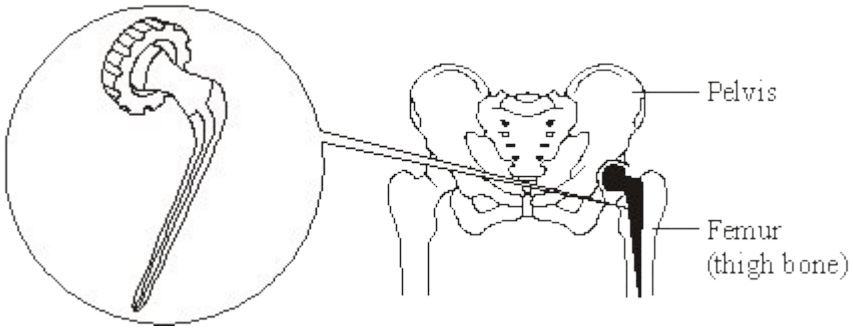
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(1)

(Total 8 marks)

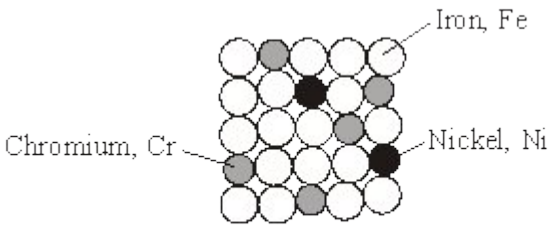
Q30.

The hip joint between the femur and pelvis sometimes has to be replaced.
Early hip replacement joints were made from stainless steel.



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

The diagram below represents the particles in stainless steel.



Particle diagram of stainless steel

(a) Use the particle diagram to complete the percentages of metals in this stainless steel.

The first one has been done for you.

Element	Percentage (%)
Iron, Fe	72
Chromium, Cr	

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Nickel, Ni	

(2)

(b) Pure iron is a relatively soft, metallic element.

(i) Why is iron described as an *element*?

_____

_____

(1)

(ii) Suggest why pure iron would **not** be suitable for a hip replacement joint.

_____

_____

(1)

(iii) Use the particle diagram to help you to explain why stainless steel is harder than pure iron.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q31.

The demand for iron and steel is high.

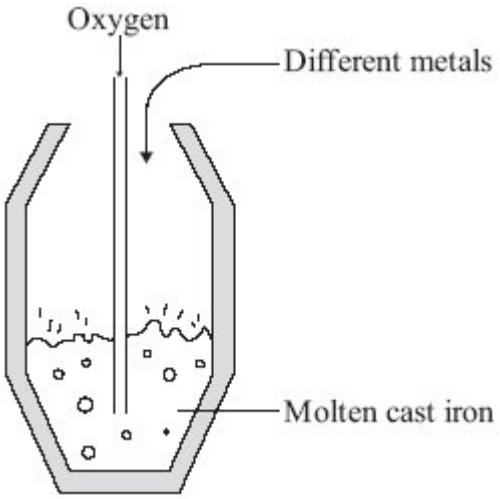
(a) Iron that is extracted from its oxide by carbon reduction in a blast furnace is called cast iron. Cast iron contains about 4% carbon. This carbon makes cast iron very brittle.

Carbon steels can be made by the following processes.

- Blowing oxygen into molten cast iron to remove most of the carbon.
- Adding a calculated amount of carbon.

Sometimes different metals may also be added to the molten carbon steels.

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(i) Suggest how blowing oxygen into molten cast iron removes most of the carbon.

_____

_____

_____

_____

(2)

(ii) Why are different metals sometimes added to molten carbon steels?

_____

_____

(1)

(b) The percentage of iron and steel recycled in the UK has been increasing.

Year	%iron and steel recycled
1998	25
2000	35
2002	42
2004	46
2006	57

The UK government has set targets for the percentage of iron and steel to be recycled.
In 2006 the target was exceeded.

Suggest **two** reasons why the UK government wants to encourage recycling of iron and steel.

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1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

Q32.

(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)

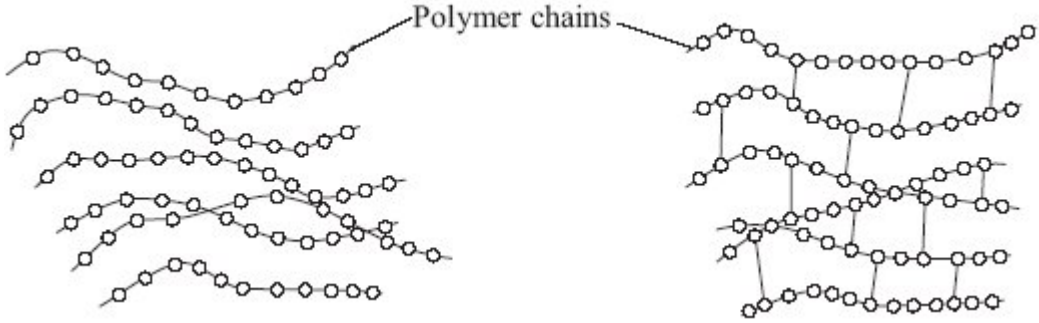
(ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

_____

_____

(1)

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



Poly(ethene) **PEX**

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

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

_____

_____

_____

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_____

_____

(3)

(b) Copper was considered to be the most 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 ore is powdered and concentrated.
2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
3 Oxygen is blown into the impure, molten copper to remove any sulfur. The 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.

1 Fractional distillation
2 Cracking
3 Polymerisation
4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

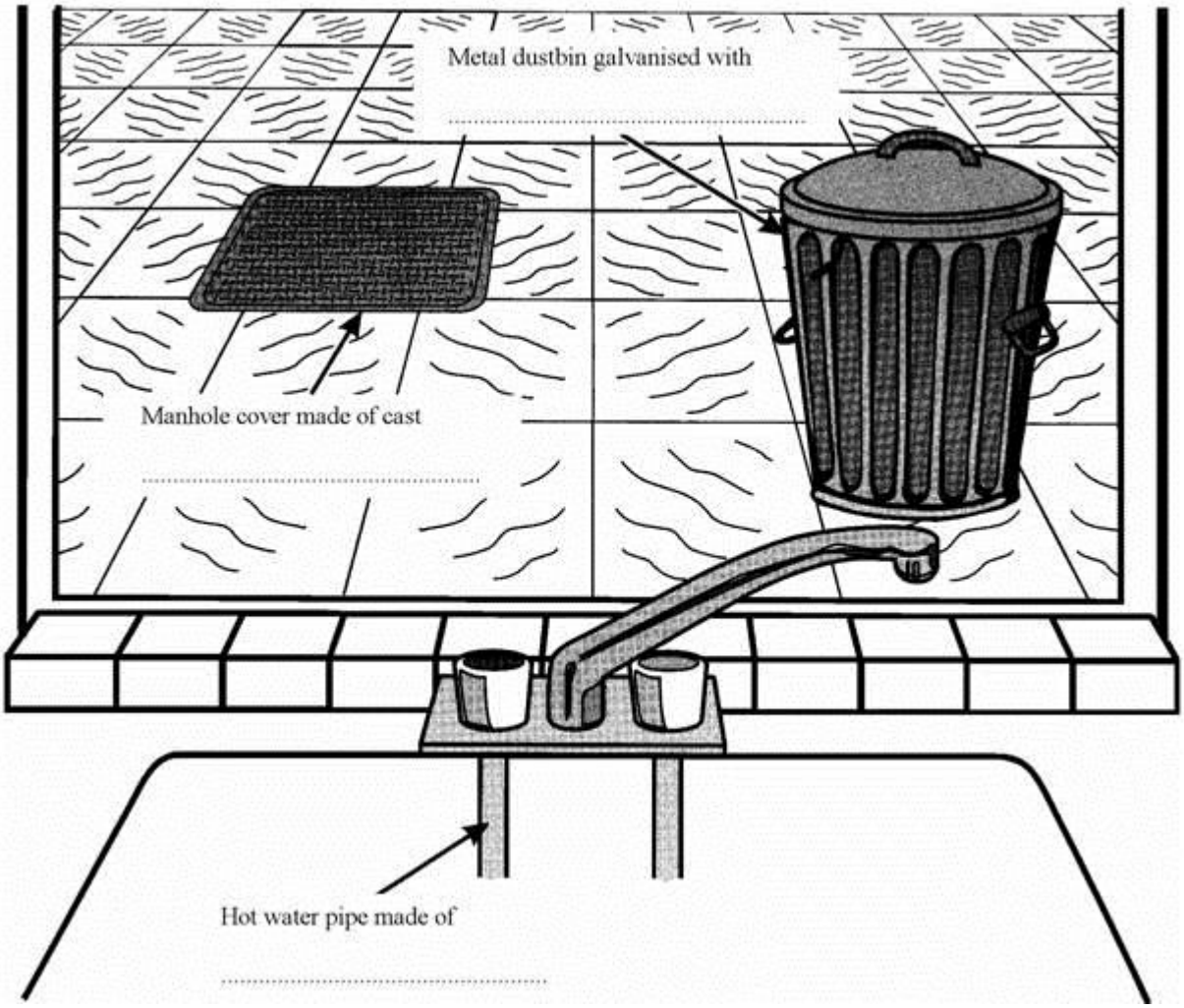
Q33.

The word box contains the names of some metals.

aluminium	copper	iron	manganese	zinc

(i) The drawing shows the view from a window. Choose from the names of metals in the box to complete the **three** spaces.

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(3)

(ii) What is the name of the metal in the word box which has the chemical symbol Fe?

_____

(1)

(iii) What is the name of **one** metal in the word box which often has coloured compounds?

_____

(1)

(Total 5 marks)

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