Questions

Q1.

Solder is an alloy of tin and lead.

A sample of a solder was made by mixing 22.5 g of lead with 15.0 g of tin.

Calculate the percentage of tin in this solder.

(2)

percentage of tin = ... %

(Total for question = 2 marks)

Q2.

Many metals corrode.

An experiment is carried out to see if magnesium ribbon wrapped around a piece of iron rod has an effect on the rate at which the iron rod rusts.

The apparatus is shown in Figure 4.

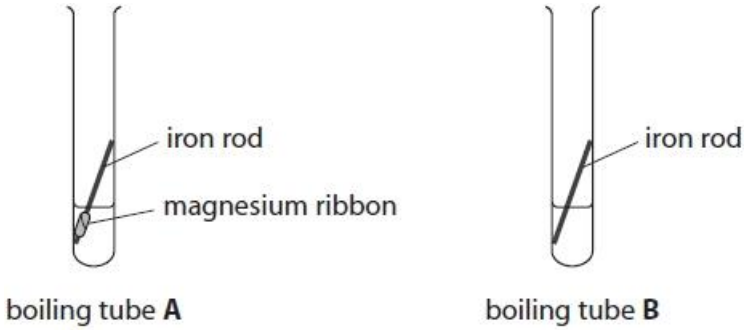

Figure 4

The method used is

- an iron rod, with magnesium ribbon wrapped around it, is placed in a boiling tube labelled **A**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube
- an identical rod but with no magnesium ribbon wrapped around it is placed in a second boiling tube labelled **B**
- 10 cm^3 water from a measuring cylinder is poured into this boiling tube.

Both boiling tubes are left for a few days.

(i) Explain why iron rod rather than stainless steel rod is used in this experiment.

(2)

.....

.....

.....

.....

(ii) State why it is not necessary to use a pipette to measure out 10 cm^3 water in this experiment.

(1)

.....

(iii) After a few days the two boiling tubes were examined.

The results are shown in Figure 5.

boiling tube A	the appearance of the iron rod is unchanged the magnesium has started to disappear
boiling tube B	a small amount of brown deposit has formed around the rod

Figure 5

Explain the results of this experiment.

(2)

.....

.....

.....

.....

(Total for question = 5 marks)

Q3.

A 695.0 g sample of an aluminium-magnesium alloy contains 2.00 % by mass of magnesium.

Calculate the mass of aluminium in this sample.

(2)

.....

.....

mass of aluminium = ... g

(Total for question = 2 marks)

Q4.

A gold alloy contains 78 % gold by mass.

Calculate the mass of gold in 2.00 kg of this alloy.
Give your answer in grams.

(3)

.....

.....

.....

mass = ... g

(Total for question = 3 marks)

Q5.

Gold is often alloyed with other metals when it is used to make jewellery.

The proportion of gold in a piece of gold jewellery is measured in carats.

Pure gold is 24 carats.

A 9 carat gold ring has a mass of 12 g.

Calculate the mass of gold in this ring.

(2)

mass of gold ring = ... g

(Total for question = 2 marks)

Q6.

Transition metals have many uses.

The pie chart in Figure 6 shows the uses of one transition metal.

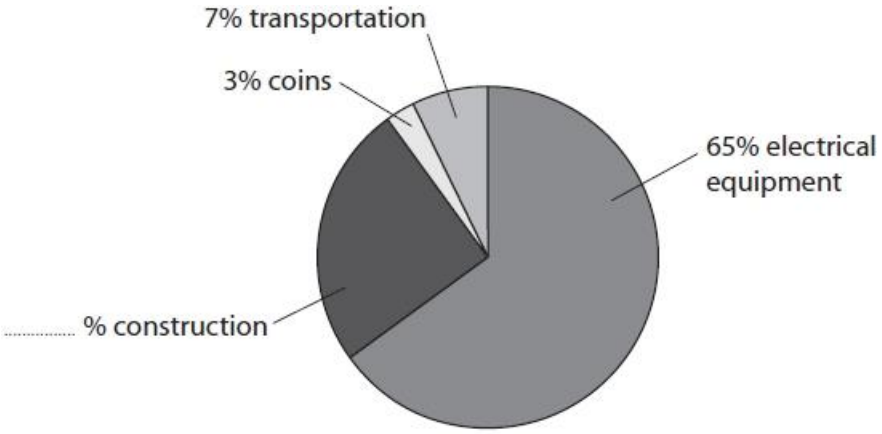

Figure 6

Calculate the percentage of this transition metal used in construction.

(1)

.....

percentage of this transition metal used in construction =
.....

(Total for question = 1 mark)

Q7.

Iron objects can corrode when exposed to the atmosphere.

(i) Corrosion involves the oxidation of iron.
State what is meant by **oxidation**.

(1)

.....

.....

.....

(ii) Painting iron objects prevents corrosion.
Explain why painting iron objects prevents corrosion.

(2)

.....

.....

.....

.....

(iii) Corrosion of iron objects can be prevented by painting them or by electroplating them.
State one **other** way of preventing the corrosion of iron objects.

(1)

.....

(Total for question = 4 marks)

Q8.

Figure 12 shows a graph of the relative strength of aluminium-magnesium alloys when the percentage by mass of magnesium in the alloy is changed.

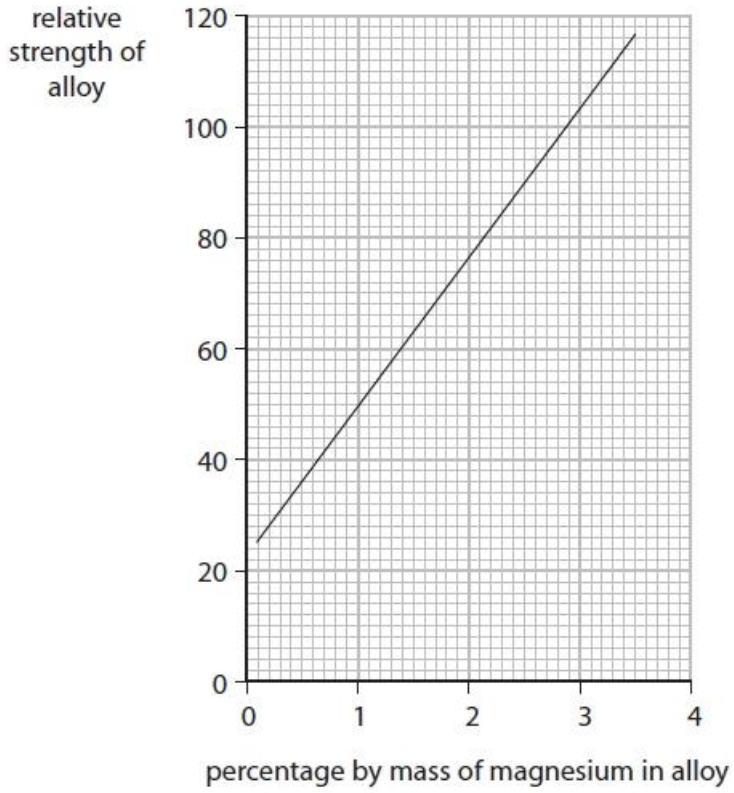

Figure 12

(i) Describe what Figure 12 shows about the relative strength of these alloys when the percentage by mass of magnesium changes.

(2)

.....

.....

.....

(ii) Determine, using Figure 12, the percentage by mass of aluminium in an aluminium-magnesium alloy with a relative strength of 103.

(2)

.....

.....

percentage by mass of aluminium = ...

(Total for question = 4 marks)

Q9.

Copper is a transition metal.

Magnesium reacts with copper sulfate solution to form copper and a solution of magnesium sulfate.
Magnesium sulfate solution is colourless.

Describe **two** changes you would **see** during this reaction.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

Q10.

Alloys of gold are often used to make jewellery.
The purity of gold is measured in carats.
Different alloys of gold have different carats.

Figure 2 shows the relationship between the purity of gold in carats and the percentage of gold in the alloy.

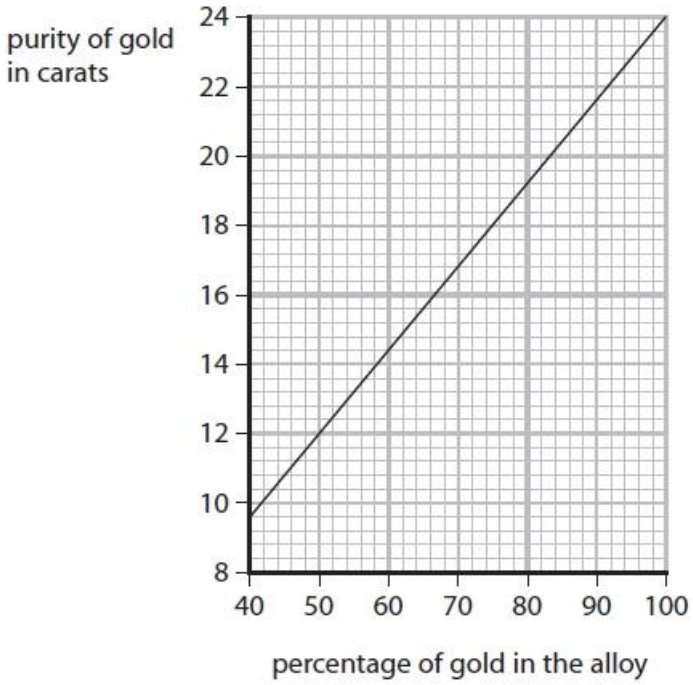

Figure 2

A necklace with a mass of 5.0 g was found to contain 2.9 g of gold.

Determine the purity of the gold necklace in carats.
Show your working.

(3)

.....

.....

.....

purity of the gold necklace = ... carats

(Total for question = 3 marks)

Q11.

* Pure metals are often converted into more useful alloys.
For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery.
These processes of alloying change the structures of the metals.

Some properties of pure aluminium, iron and gold are shown in Figure 12.

	density in g cm^{-3}	malleability	relative strength
aluminium	2.70	easy to bend	low
iron	7.75	easy to bend	low
gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(Total for question = 6 marks)

Q12.

Duralumin is an alloy of aluminium and copper.

The radii of the aluminium and copper atoms are shown in Figure 11.

	radius of atom / m
aluminium	1.43×10^{-12}
copper	1.27×10^{-12}

Figure 11

Explain why copper added to aluminium to form the alloy makes the alloy stronger than pure aluminium.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q13.

* Pure metals can be made more useful by converting them into alloys or by electroplating them.

Explain what alloying and electroplating are and how they can make metals more useful.

(6)

(Total for question = 6 marks)

Q14.

Alloys of gold are often used to make jewellery.
The purity of gold is measured in carats.
Different alloys of gold have different carats.

Figure 1 shows the percentage of different metals in two samples of gold.

	percentage of metal		
	gold	silver	copper
18 carat gold	75.0	15.0	10.0
24 carat gold	100.0	0.0	0.0

Figure 1

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

You may use diagrams to help your answer.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q15.

Aluminium alloys are used instead of pure aluminium in aircraft manufacture.

Explain, in terms of the arrangement of metal particles, why aluminium alloys are stronger than pure aluminium.

(3)

.....

.....

.....

.....

(Total for question = 3 marks)

Q16.

(i) Explain why covering iron tools with a thin layer of grease prevents rusting.

(2)

.....

.....

.....

(ii) Sacrificial protection is another way of preventing rusting.

An example of sacrificial protection is when lumps of zinc are connected to the iron-containing structure of an oil rig.
Explain how the zinc protects the iron from rusting.

(2)

.....

.....

.....

(Total for question = 4 marks)

Q17.

Alloys are mixtures of two or more metals.

Magnalium is an alloy of magnesium and aluminium.
It is often used for aircraft parts.

(i) Figure 4 shows information about pure aluminium and magnalium.

substance	density in g cm^{-3}	relative strength	resistance to corrosion
aluminium	2.7	low	high
magnalium	2.0	high	very high

Figure 4

Explain, using the information in Figure 4, why magnalium, rather than pure aluminium, is used for aircraft parts.

(3)

.....

.....

.....

.....

.....

.....

(ii) 63.0 g of magnalium contains 3.15 g of magnesium.

Calculate the percentage by mass of magnesium in the magnalium.

(2)

.....

.....

.....

.....

percentage of magnesium in the magnalium = ...

(Total for question = 5 marks)

Q18.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Iron rusts when it is left in certain conditions.

(i) Figure 9 shows the apparatus used to investigate the rusting of some iron nails.

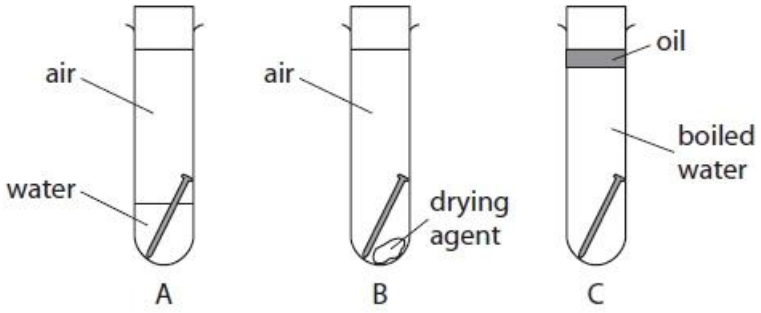

Figure 9

Explain why the iron nail in tube A would rust but the iron nails in tubes B and C would not rust.

(3)

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.....

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.....

(ii) Magnesium is more reactive than iron.

Figure 10 shows an iron nail with a strip of magnesium wrapped around it, placed in some water.
The tube was left for a few days.

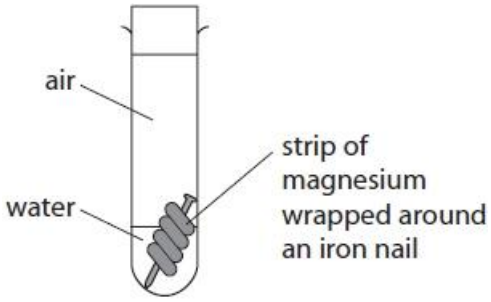

Figure 10

State what would happen to this iron nail.

(1)

.....

.....

(iii) When iron rusts, a brown solid forms on the surface of the iron.

What happens to the iron as the rust forms?

(1)

- ☒ **A** the iron is hydrated
- ☒ **B** the iron is neutralised
- ☒ **C** the iron is oxidised
- ☒ **D** the iron is reduced

(Total for question = 5 marks)

Q19.

An iron bucket is coated in zinc.
Over many years of use, the iron bucket has been scratched and left outside in the rain. Although some of the zinc coating has been removed to expose iron, the iron bucket has not rusted.

Explain why the iron has not rusted.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q20.

Alloy steels are made when iron is alloyed with other transition metals such as cobalt and chromium.

Iron fences can be galvanised by coating them with a layer of zinc. When the layer of zinc is scratched exposing the iron to the weather, the iron does not rust.

Explain why the exposed iron does not rust.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q21.

Alloys are mixtures of two or more metals.

Brass is an alloy of copper.
Figure 3 shows the brass pins of an electric plug.

(Source: © Adamlee01/Shutterstock)

Figure 3

Brass is harder than copper.

Give a reason why using a harder substance for the pins is an advantage.

(1)

.....

.....

(Total for question = 1 mark)

Q22.

Give **two** advantages for electroplating some metal objects.

(2)

.....

.....

(Total for question = 2 marks)

Q23.

Give **one** reason why metals are electroplated.

(1)

.....

.....

(Total for question = 1 mark)

Q24.

Rusting is the corrosion of iron.

(i) Water is one of two substances needed for iron to rust.

Give the name of the **other** substance needed for iron to rust.

(1)

.....

(ii) The rate of rusting can be increased by using sea water.

Describe a simple experiment to compare how much an iron nail rusts in sea water when compared to water.

(3)

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.....

.....

.....

.....

.....

(iii) Rusting can be prevented by galvanising iron which involves coating the iron with a layer of zinc.

A small iron bucket was galvanised. The surface area of the bucket was 0.68 m^2.
Calculate the mass of zinc required to coat the surface of the bucket with a layer of zinc of 200 g m^{-2}.

(1)

.....

.....

.....

mass of zinc = ... g

(Total for question = 5 marks)

Q25.

Alloys are mixtures of two or more metals.

Alloy steels are formed when other metals are mixed with iron.

Cutlery is made of stainless steel.

Give **two** reasons why cutlery is made of stainless steel rather than iron.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

Q26.

Metal objects can be electroplated with gold.

Give two reasons why metal objects are electroplated with gold.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

Q27.

Transition metals have many uses.

Figure 7 shows five statements about iron.

Put ticks (✓) in the boxes in Figure 7 to show which statements are true and which statements are false.
The first one has been done for you.

(3)

	true	false
iron is a poor conductor of heat		✓
iron can act as a catalyst		
iron forms compounds that are coloured		
iron has a low density		
iron has a very high melting point		

Figure 7

(Total for question = 3 marks)

Q28.

*The pure metals aluminium, copper and gold and the alloys brass and magnalium are used to make many useful articles.

The way in which these metals and alloys are used is related to their properties, such as their density, electrical conductivity, resistance to corrosion and strength.

State some uses of aluminium, copper, gold, brass and magnalium and explain how each use is related to their properties.

(6)

(Total for question = 6 marks)

Q29.

The apparatus shown in Figure 13 was used to electroplate a spoon with nickel.

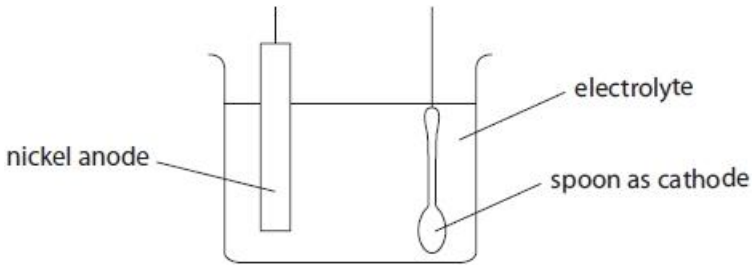


Figure 13

(i) State to what the anode and cathode have to be connected in order to carry out the electroplating.

(1)

.....

(ii) Predict the name of a substance that could be dissolved in water to form the electrolyte for this electroplating.

(1)

.....

(Total for question = 2 marks)

Q30.

This question is about the metal gold.

(i) Gold can be hammered into shape.

State the name of this property.

(1)

.....

(ii) Gold alloys can be used to repair teeth.
One reason that gold alloys are used is that they can be hammered into shape.

Give **one other** reason why gold alloys are used to repair teeth.

(1)

.....

.....

.....

(Total for question = 2 marks)

Q31.

In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.

Some metal objects are electroplated.

State **two** reasons for electroplating a metal object.

(2)

1 .....

.....

2 .....

.....

(Total for question = 2 marks)

Q32.

Transition metals have many uses.

Most iron produced is converted into alloys of iron.

(i) State why alloys have more uses than pure metals.

(1)

.....

.....

(ii) An alloy of iron contains 0.40 % of molybdenum.

Calculate the mass of molybdenum contained in a 30 g sample of this alloy of iron.

(2)

.....

.....

.....

.....

mass of molybdenum = ... g

(Total for question = 3 marks)

Q33.

In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.

The electrodes of a fuel cell are in contact with water and air.
The electrodes are made of platinum rather than iron.

(i) State why iron is not a suitable metal for the electrodes of the cell.

(1)

.....

.....

.....

(ii) Platinum acts as a catalyst.

State, in terms of its position in the periodic table, why you would expect platinum to act as a catalyst.

(1)

.....

.....

.....

(Total for question = 2 marks)

Q34.

The rusting of an iron nail was investigated by setting up three test tubes, as shown in Figure 6.

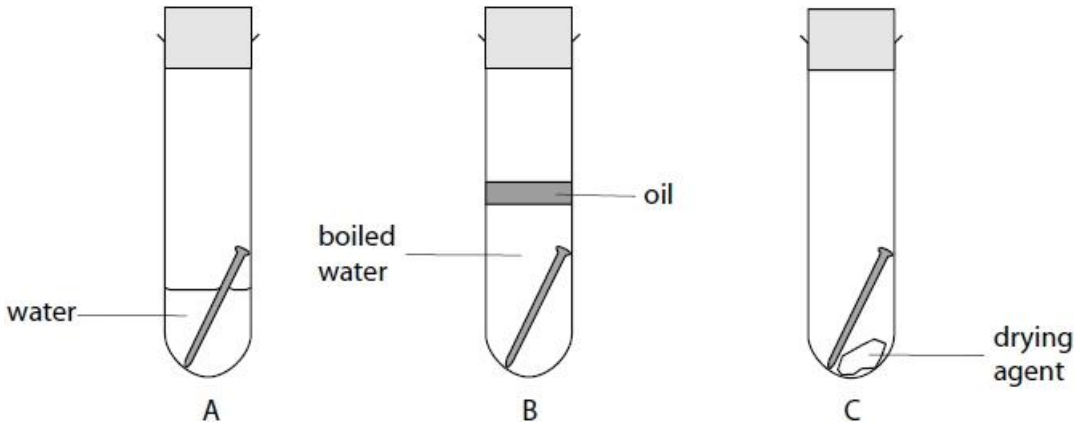


Figure 6

State and justify the result you would see in each tube after one week.

(3)

A .....

.....

B .....

.....

C .....

.....

(Total for question = 3 marks)

Q35.

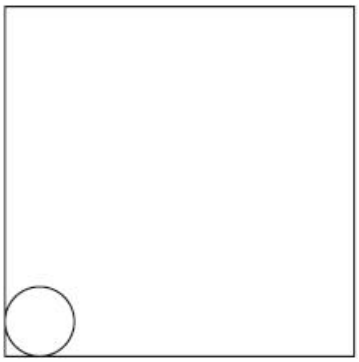
Brass is an alloy of copper and zinc.
One type of brass contains 70% copper.

Zinc atoms are slightly larger than copper atoms.

Draw a labelled diagram in the box to show the arrangement of copper and zinc atoms in this alloy.

Use the circle in the box as a guide to the size of a copper atom.

(2)



(Total for question = 2 marks)

Q36.

Many metals corrode.

Hydrazine, N_2H_4, reacts with oxygen.

$$N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$$

A metal in water corrodes faster than an identical piece of metal in the same volume of water containing dissolved hydrazine.

Use the information to explain how hydrazine slows corrosion.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q37.

Alloy steels are made when iron is alloyed with other transition metals such as cobalt and chromium.

Figure 1 shows the chain on a bicycle.

Figure 1

Explain how lubricating the chain with oil prevents corrosion of the steel chain.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
	% of tin in alloy = $\frac{15.0}{(15.0+22.5)} \times 100$ (1) = 40.0 (%) (1)	Award full marks for correct numerical answer without working.	(2)

Q2.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • stainless steel resistant to {corrosion/ rusting/ oxidation} / corrosion rate slower / does not react with {air/oxygen} and water • neither rod would rust/ react (in a few days) / there would be no {rusting / reaction}/ no change would occur / it would take a long time for any result (1)	Ignore iron corrodes but ALLOW iron corrodes **faster** than stainless steel / iron rusts but stainless steel does not (1)	(2)
(ii)	measuring cylinder accurate enough / accuracy of pipette not needed / no need to be (more) accurate / the volume of water is not critical	allow exact/ precise for accurate allow pipettes only used for accurate/ precise/ exact volumes	(1)
(iii)	An explanation linking • (A) the magnesium has {corroded/ reacted/ oxidised} / (B) {rusting / corrosion / oxidation} has occurred (1) • because magnesium is more reactive than iron / (magnesium has reacted) instead of the iron (1)	MP1 describes reaction that occurs MP2 reason – ignore 'sacrificial protection' etc.	(2)

Q3.

Question number	Answer	Additional guidance	Mark
	$\frac{2.00}{100}$ x 695.0 (1) (= 13.9) 695.0 - 13.9 (1) (= 681.1 (g)) OR $\frac{98.00}{100}$ (1) x 695.0 (1) (= 681.1 (g))	award full marks for correct final answer without working allow 2 or more sig.fig.	**(2)** **AO2**

Q4.

Question number	Answer	Mark
	1560 with or without working scores 3 78 / 100 (1) 78 / 100 x 2.00 (1) (= 1.56 kg) 1.56 x 1000 (1) (= 1560 g)	**(3)** **AO2**

Q5.

Question number	Answer	Additional guidance	Mark
	proportion gold = 9 ÷ 24 (= 0.375) (1) mass = 0.375 × 12 = 4.5 (g) (1)	Award full marks for correct numerical answer without working.	**(2)**

Q6.

Question number	Answer	Additional guidance	Mark
	100 – 65 – 7 – 3 (1) (= 25)	25 alone scores 1	**(1)**

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	gain of oxygen	allow loss of electrons allow addition of oxygen ignore oxygen reacts with metal/substance	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking • the paint {excludes/acts as a barrier/protective layer/shield} (1) • (excludes) air / oxygen / water (1)	 allow rain or moisture for water	**(2)** AO 2 2

Question Number	Answer	Additional guidance	Mark
(iii)	sacrificial protection	allow coat with plastic / oil / grease allow galvanising allow add a more reactive metal ignore to make an alloy ignore painting ignore electroplating ignore add another metal alone ignore keep away from water/air/oxygen	**(1)** AO 1 2

Q8.

Question number	Answer	Additional guidance	Mark
(i)	A description to include • the strength increases (1) AND any one from • as percentage of magnesium (by mass in the alloy) increases (1) • linearly (1) • from 0.1 % to 3.5 % magnesium (1)	MP2 is dependent on MP1	(2) AO3

Question number	Answer	Additional guidance	Mark
(ii)	(from graph) percentage by mass of magnesium = 3.0 % (1) percentage aluminium in alloy = 100 - 3 (1) (= 97 (%))	credit MP1 if written on graph ecf	(2) AO3

Q9.

Question number	Answer	Additional guidance	Mark
	A description to include two from • {colour / blue} fades / colourless solution **forms** (1) • (red-brown) solid forms (1) • magnesium disappears (1)	 stays colourless (0) turns colourless (1) ignore wrong starting colour ignore clear allow {red-brown} precipitate/ppt allow dissolves allow magnesium blackens	(2)

Q10.

Question number	Answer	Additional guidance	Mark
	final answer of 14 with or without working (3) OR $\frac{2.9}{5.0} = 0.58$ (1) 0.58 x 100 = 58% (1) 14 (1)	allow ECF allow 13.8-14.0	**(3)**

Q11.

Question Number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • an alloy is a mixture of metals • because larger/different sized atoms introduced in alloying, • stop layers moving easily over one another • therefore individual alloy is stronger/harder • an aluminium alloy is magnalium • pure aluminium is not suitable for making aircraft as it bends too easily / too weak • aluminium alloy stronger • magnesium atoms lighter than aluminium atoms, • therefore alloy still low density / lower density than aluminum alone • an iron alloy is stainless steel • pure iron is not suitable for cutlery as it bends too easily / too weak • iron corrodes, • corrosion would contaminate food • stainless steel does not corrode • gold alloy harder • therefore more hard wearing • gold alloys less likely to change shape when worn • alloying can change the colour of the gold	**(6)** AO 2 1 AO 3 1a AO 3 1b

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3-4	• The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5-6	• The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Q12.

Question number	Answer	Mark
	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • aluminium and copper have different size atoms (1) • and so this prevents the layers of metal atoms from sliding over one another (1)	**(2)**

Q13.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • in an alloy another metal is added / a mixture of metals • in a pure metal, all atoms are of the same size • layers of atoms can slide over one another easily • so a pure metal is malleable / soft • alloys are stronger • because atoms of different sizes • disrupt layers of atoms in the alloy • layers cannot slide • alloys can be used e.g. in metal beams / airplanes parts / bridges • because the alloy is stronger than the pure metal • electroplating means that a (corrosion resistant) metal {coating / layer} is added on top of the (pure) metal / alloy • (more reactive) metals can corrode when exposed to air and water • (corrosion resistant) metal coating does not react with oxygen in air • therefore pure metal object does not corrode • object remains shiny • object looks more attractive • base metal is often cheaper e.g. copper plated with gold in jewellery • therefore object may be cheaper • electroplating involves creating a circuit • object to be plated is made the cathode • plating metal is the anode • electrolyte made from plating metal salt solution	**(6)**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Descriptor	Possible candidate response
Read whole answer. Ignore all incorrect material and discard any contradictory material.			
	0	No rewardable material.	
Level 1	1–2	Candidate gives basic ideas about the uses of structure of alloys or electroplated materials: OR	Possible candidate responses alloys can be used for car parts (1) alloys are stronger than pure metals and cutlery is electroplated (2)
Level 2	3–4	Candidate gives basic ideas about both processes: OR Candidate gives a detailed explanation about one processes:	Possible candidate responses alloys make items stronger because the layers of atoms cannot slide, electroplating helps prevent items corroding (3) electroplating is used to coat cheaper metals in more expensive metals to make them look shiny, alloys are a mixture of metals they are more resistant to corrosion (4) alloys used in construction means that they are stronger as different sized atoms in the structure disrupt the layers of atoms so that they can no longer slide so that the metal is now stronger (4) Cutlery can be electroplated with a less corrosive metal so that the metal remains shiny, the layer of metal stops the iron coming into contact with oxygen and water so that it does not rust (4)
Level 3	5–6	Candidate explains ideas about both processes:	Possible candidate responses alloys used in construction means that they are stronger as different sized atoms in the structure disrupt the layers of atoms so that they can no longer slide so that the metal is now stronger. Electroplating coats a cheaper metal in an expensive metal (5) Cutlery can be electroplated with a less corrosive metal so that the metal remains shiny, the layer of metal stops the iron coming into contact with oxygen and water so that it does not rust. Alloys can be used in car parts and in metal beams for construction as it makes them stronger (6)

Q14.

Question number	Answer	Additional guidance	Mark
	An explanation linking • (18 carat gold) contains atoms of different sizes/ORA (1) • disrupts structure of metal / prevents layers from {slipping / sliding /moving} over one another (1)	reject molecules once allow particles/ions for atoms allow particles / atoms / sheets / rows for layers	**(2)**

Q15.

Question number	Answer	Additional guidance	Mark
	An explanation linking • (in pure aluminium all the atoms are the same (size) whereas) in alloy atoms are different sizes (1) • (in aluminium) {layers/rows/sheets} of atoms easily slide over each other (1) • (in alloy) {layers/rows/sheets} of atoms cannot easily slide over each other (1)	reject the use of 'molecules' once only allow ion/particle in place of atom throughout	**(3)** **AO1**

Q16.

Question number	Answer	Mark
(i)	An explanation including any two from • air/oxygen excluded (1) • water excluded (1) • air/oxygen/water needed for corrosion (1)	**(2)** **AO2**

Question number	Answer	Mark
(ii)	An explanation including • zinc is more reactive (than iron) (1) • so reacts instead (1)	(2) AO1

Q17.

Question number	Answer	Additional guidance	Mark
(i)	An explanation to include • magnalium has a **lower** density than aluminium ORA (1) • magnalium is **stronger** than aluminium ORA (1) • magnalium has a **higher** resistance to corrosion than aluminium ORA (1)	allow magnalium lighter	(3)
(ii)	5.0 with or without working scores 2 3.15 (1) x 100 (1) 63.0 (= 5.0)	allow any sig fig if fraction inverted then x 100 = 2000 allow (1) for 20 allow (1) allow any fraction using data x 100 (1)	(2)

Q18.

Question number	Answer	Mark
(i)	An explanation linking • both {air/oxygen} and water needed for rusting (1) then any two from • tube a – {air/oxygen} and water present (1) • tube b – only dry {air/oxygen} present / no water (1) • tube c – only water present (with nail) / no {air/oxygen} (1)	(3)

Question number	Answer	Additional guidance	Mark
(ii)	No rusting / remains clean / does not corrode	ignore any statements about magnesium	(1)

Question number	Answer	Mark
(iii)	**C** the iron is oxidised **The only correct answer is C** **A** is not correct – hydration is a different reaction **B** is not correct – neutralisation involves an acid **D** is not correct – reduction is loss of oxygen or gain of electrons which does not happen here	**(1)**

Q19.

Question number	Answer	Mark
	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • (iron has not rusted because) zinc is more reactive than iron (1) • so zinc corrodes instead of iron (1)	**(2)**

Q20.

Question Number	Answer	Additional guidance	Mark
	An explanation linking • zinc corrodes {easier than / in preference to / OWTTE} iron / zinc reacts with air and water instead (1) • zinc is more reactive than iron / zinc is sacrificial / zinc has a higher tendency to form ions (1)	reject zinc rusts	**(2)** AO 1 1 AO 2 1

Q21.

Question number	Answer	Additional guidance	Mark
	pins do not bend (1)	ignore less likely to break allow less malleable	**(1)**

Q22.

Question number	Answer	Mark
	• improve appearance (1) • help prevent corrosion (1)	(2)

Q23.

Question number	Answer	Additional guidance	Mark
	improve appearance / more corrosion resistant	allow suitable alternative answers ignore cost	(1)

Q24.

Question number	Answer	Additional guidance	Mark
(i)	oxygen	allow O_2	(1)

(ii)	A description to include three from • clean iron nails (1) • place a nails into test tubes of water and sea water (1) • leave test tubes for a period of time (1) • observe the tubes and record any changes to compare {appearance/mass} (1)	allow correct idea of timing (1)	(3)

Question number	Answer	Additional guidance	Mark
(iii)	0.68 x 100 (1) (= 136 (g))		(1)

Q25.

Question number	Answer	Additional guidance	Mark
	• stainless steel does not {rust / corrode} ORA (1) • stainless steel is stronger ORA (1)	allow stainless steel harder	(2)

Q26.

Question number	Answer	Additional guidance	Mark
	• improve the appearance (1) • increase resistance to corrosion (1)	allow • to improve electrical conductivity (1) • cheaper than using solid gold (1)	(2) AO1

Q27.

Question number	Answer	Additional guidance	Mark
		(first tick given) 4 correct ticks = 3 marks 3 or 2 correct ticks = 2 marks 1 correct tick = 1 mark	(3)

	true	false
iron is a poor conductor of heat		✓
iron can act as a catalyst	✓	
iron forms compounds that are coloured	✓	
iron has a low density		✓
iron has a very high melting point	✓	

Q28.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • suitable use of aluminium eg cooking foil • related property – malleable, low toxicity, low reactivity • suitable use of copper eg water pipes • related property – low reactivity • suitable use of gold eg electronic contacts • related property – does not corrode, good electrical conductor • suitable use of brass eg pins for electric plugs • related property – strong and hard wearing • suitable use of magnalium eg aircraft parts • related property – low density	**(6)**

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by planning detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Identifies at least one property OR use of at least one metal or alloy and attempts to relate it to a suitable use.	Possible candidate responses • aluminium has a low density (alone) • gold can be used in jewellery (alone) • copper is used in wiring because it is a good conductor of electricity (upper part of level)
Level 2	3–4	Additional guidance Identifies at least one property alloys and links of two metals OR this to their uses.	Possible candidate responses • copper and gold are both used in electrical wiring because they are good conductors of electricity • copper is used in wiring because it is a good conductor of electricity. Gold is used in jewellery • magnalium has a low density so can be used in aircraft parts. Gold can be used in jewellery because it is unreactive – upper part of level
Level 3	5–6	Additional guidance Identifies properties of at least one metal AND one alloy and explains their uses related to these properties.	Possible candidate responses • copper is used in electrical wiring because it is a good conductor of electricity so a current can pass through it. Magnalium is used in aircraft parts because it has a low density • gold is used in jewellery because it is unreactive and so will not cause irritation to the wearer. Brass is used for making electrical plug pins because it is strong, so will not break easily – upper part of level

Q29.

Question Number	Answer	Additional guidance	Mark
(i)	dc (supply) / direct current / battery	allow power pack allow electrical supply allow power supply allow power source ignore electricity	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	nickel sulfate/nickel chloride/nickel nitrate/soluble nickel salt		(1) AO 3 3a

Q30.

Question number	Answer	Mark
(i)	malleable / malleability	(1) AO2

Question number	Answer	Additional guidance	Mark
(ii)	does not corrode/ insoluble/ unreactive/ inert / non-toxic / hard	ignore references to appearance	(1) AO2

Q31.

Question number	Answer	Additional guidance	Mark
	Any two from: • improves the appearance/ shiny (1) • improves resistance to corrosion/ does not corrode/ prevents reaction with {air/oxygen/water}/ prevents oxidation (1) • can make e.g. 'gold' object more cheaply using a gold layer on a cheaper base / looks more expensive than it is (1)	 allow does not rust ignore durable/ protects unqualified etc. ignore 'makes more valuable'	(2)

Q32.

Question number	Answer	Additional guidance	Mark
(i)	alloys stronger / pure metals weaker / alloys more corrosion resistant	ignore harder ignore 'more desirable properties'	(1)

Question number	Answer	Additional guidance	Mark
(ii)	0.40 x 30 (1) (= 12) 12 (1) (= 0.12)(g) 100	0.12 (g) without working (2)	(2)

Q33.

Question number	Answer	Additional guidance	Mark
(i)	iron rusts/ corrodes/ reacts {with oxygen/ water} / iron oxidises / forms iron oxide	ignore erodes/ corrosive	(1)

Question number	Answer	Additional guidance	Mark
(ii)	platinum is a **transition** {metal/ element}	ignore 'in the middle' etc. ignore any irrelevant/ additional information	(1)

Q34.

Question number	Answer	Mark
	• A will rust, as there is air/oxygen and water present (1) • B will not rust, as there is no air/oxygen present (1) • C will not rust, as no water is present (1)	(3)

Q35.

Question number	Answer	Additional Guidance	Mark
	Diagram showing • arrangement of labelled copper and zinc atoms to show disruption (1) • copper : zinc in (approximate) ratio 7 : 3 (1)	minimum 2 layers for mark allow lack of labelling if clear distinction between Zn & Cu (eg shading)	**(2)** AO1-1

Q36.

Question number	Answer	Additional guidance	Mark
	An explanation linking • {less oxygen / no oxygen / oxygen is removed} by the hydrazine (1) • oxygen is needed for {rusting / reaction} / corrosion/so oxidation prevented (1)	For MP1 allow 'oxygen reacts with hydrazine instead of the metal' (1) ignore hydrazine {displaces/ more reactive than} oxygen no oxygen so no rusting scores 2	**(2)**

Q37.

Question Number	Answer	Mark
	An explanation linking • {air/oxygen} excluded / {water/moisture} excluded / oil acts as a barrier (1) • {air/oxygen} **and** {water/moisture/damp conditions} both needed (for iron to rust / corrosion) (1)	**(2)** AO 1 1