

1

An atom of aluminium has the symbol ${}_{13}^{27}\text{Al}$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons

Number of neutrons

Number of electrons

(3)

(b) Why is aluminium positioned in Group 3 of the periodic table?

.....

.....

(1)

- (c) In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in the table below.

	Transition elements		Group 1 elements	
	Chromium	Iron	Sodium	Caesium
Melting point in °C	1857	1535	98	29
Formula of oxides	CrO Cr ₂ O ₃ CrO ₂ CrO ₃	FeO Fe ₂ O ₃ Fe ₃ O ₄	Na ₂ O	Cs ₂ O

Use your own knowledge **and** the data in the table above to compare the chemical and physical properties of transition elements and Group 1 elements.

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(6)
(Total 10 marks)

2

Copper is a transition metal.

(a) (i) Where is copper in the periodic table?

Tick (✓) **one** box.

in the central block

in Group 1

in the noble gas group

(1)

(ii) What is a property of copper?

Tick (✓) **one** box.

breaks easily

conducts electricity

does not conduct heat

(1)

(b) Copper ores are quarried by digging large holes in the ground, as shown in **Figure 1**.

Figure 1



© photllurg/iStock/Thinkstock

Give **two** reasons why quarrying is bad for the environment.

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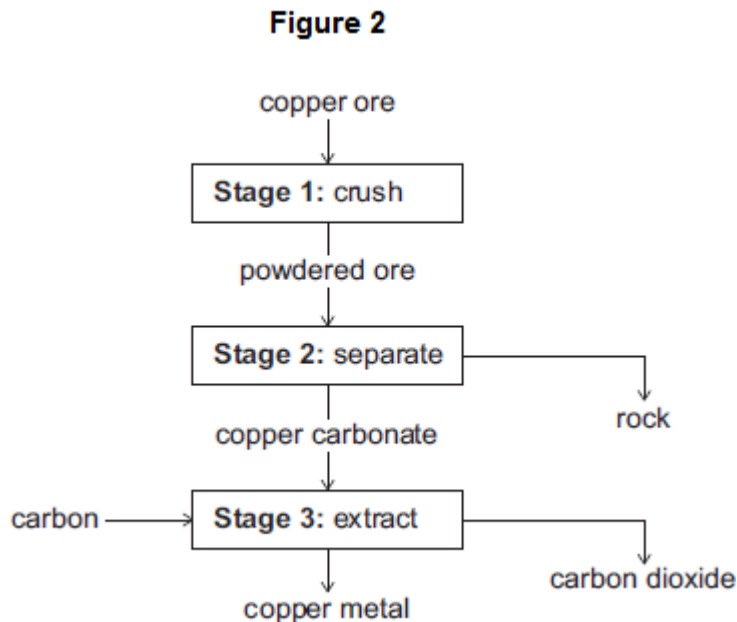
(2)

(c) Some copper ores contain only 2% copper.

Most of the ore is rock that is not needed.

In one ore, the main compound is copper carbonate (CuCO₃).

Figure 2 shows the stages used in the extraction of copper from this ore.



(i) Why is **Stage 2** important?

.....

(1)

(ii) The equation for the reaction in **Stage 3** is:



From the symbol equation, a company calculated that 247 tonnes of copper carbonate are needed to produce 127 tonnes of copper and 132 tonnes of carbon dioxide are released.

Calculate the mass of carbon needed to make 127 tonnes of copper.

copper carbonate	+	carbon	→	copper	+	carbon dioxide
247 tonnes	 tonnes		127 tonnes		132 tonnes

.....

(2)

(iii) Suggest **one** reason why it is important for the company to calculate the mass of reactants in **Stage 3**.

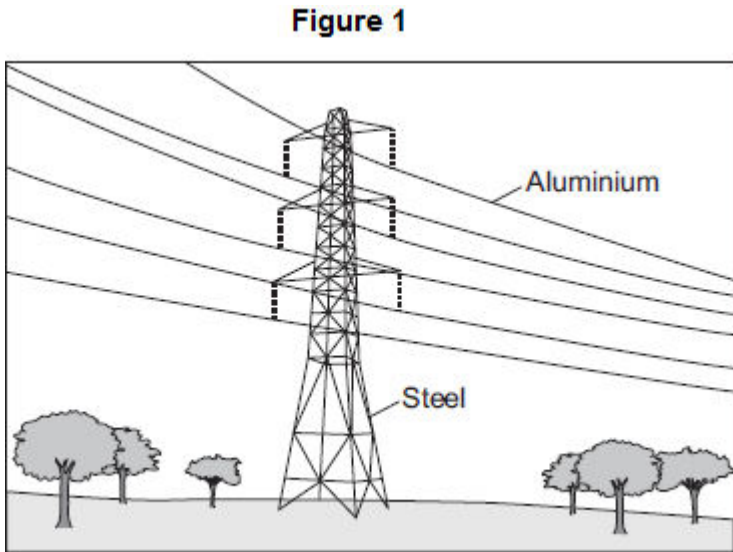
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(1)
(Total 8 marks)

3

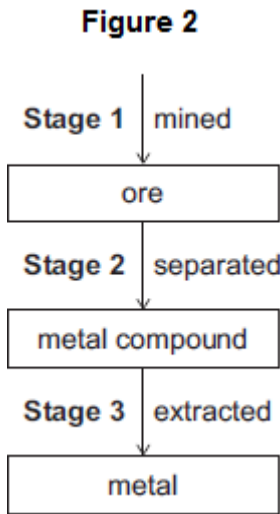
This question is about metals.

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



(a) An ore contains a metal compound.

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



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

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(2)

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

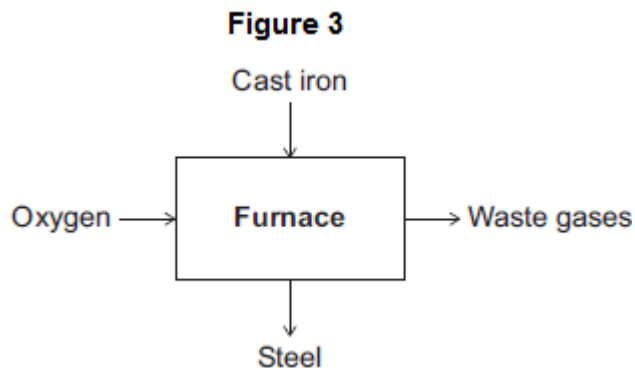
(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

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(1)

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



Describe how cast iron is converted into steel.

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

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(2)

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

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

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(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?

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(2)

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

Explain why.

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(2)


(Total 10 marks)

- (b) The table shows the melting points of the Group 1 metals arranged in alphabetical order.

Group 1 metal		
Name	Symbol	Melting point in °C
Caesium	Cs	29
Francium	Fr	27
Lithium	Li	180
Potassium	K	64
Rubidium	Rb	39
Sodium	Na	98

- (i) Arrange these metals in order of increasing melting point. Three have been done for you.

Fr Cs Li

Lowest  Highest

(1)

- (ii) Use the periodic table on the Data Sheet **and** your answer in part (b)(i) above to complete this sentence about how the melting points change.

Going down Group 1, the melting points

(1)

- (c) The transition metals are a block of elements between Groups 2 and 3 of the periodic table.
Transition metals have different properties to Group 1 metals.

Put ticks (✓) next to the **three** correct statements about transition metals in the table below.

Statement	(✓)
They are harder than Group 1 metals	
They have lower densities than Group 1 metals	
They have higher melting points than Group 1 metals	
They are more reactive with water than Group 1 metals	
They often form coloured compounds but Group 1 compounds are usually white	

(3)
(Total 10 marks)

5

Sodium is a Group 1 element.

- (a) (i) A small piece of sodium is added to some water containing Universal Indicator solution.

Describe what you would **see** happening.

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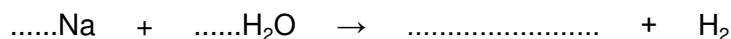
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(3)

- (ii) Complete **and** balance the equation for the reaction of sodium with water.



(2)

- (b) Francium is the most reactive element in Group 1.

Explain why in terms of electronic structure.

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(3)

- (c) The transition elements have different properties from the elements in Group 1.

Give **two** of these different properties of transition elements.

1

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2

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(2)

(Total 10 marks)

6

The periodic table on the Data Sheet may help you to answer some of these questions.

- (a) Draw a ring around the correct answer to complete these sentences.

(i)

	compounds.
Dimitri Mendeleev attempted to classify	elements.
	mixtures.

(1)

(ii)

	atomic weight.
He arranged them in order of their	boiling point.
	electrical conductivity.

(1)

(iii)

	atomic (proton) number.
They are now arranged in order of their	atomic weight.
	mass number.

(1)

(b) In the periodic table between Groups 2 and 3 there is a block of metals which includes chromium, iron and nickel.

(i) Which **one** of the following is the correct name for this block of metals?

Draw a ring around the correct answer.

alkali metals

reactive metals

transition metals

(1)

(ii) The properties of iron and those of the Group 1 metal sodium are different.

Put a tick (✓) next to the **two** correct phrases which could complete the following sentence.

Compared to sodium, iron

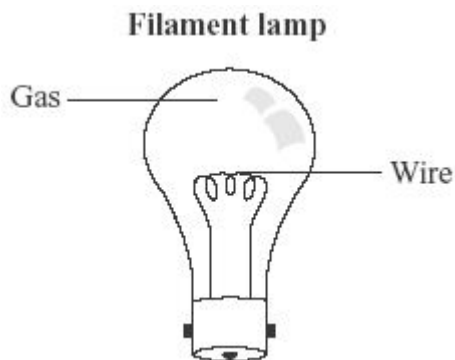
	(✓)
has a higher melting point.	
has a lower density.	
is harder.	
is more reactive.	
is weaker.	

(2)

(Total 6 marks)

7

When electricity passes through a thin wire, the wire gets hot. If the wire gets very hot, it may glow. This idea is used in filament lamps.



- (a) The table shows some metals and their melting points.

Metal	Melting point in °C
Aluminium	660
Copper	1084
Iron	1540
Tungsten	3410

Which metal in the table should be used to make the wire in a filament lamp?

Give a reason for your answer.

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.....

(2)

(b) The table shows some gases.

Gas
Argon
Carbon dioxide
Oxygen
Sulfur dioxide

Which gas in the table should be used in a filament lamp?

Give a reason for your answer.

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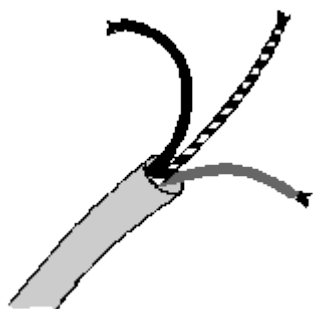
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(2)
(Total 4 marks)

8

The properties of transition metals make them useful elements.

(a) Why is copper used for electrical wiring?

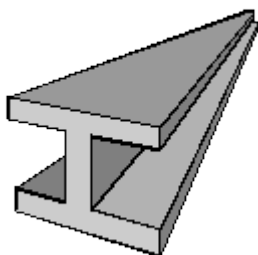


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(1)

(b) Why is iron used for girders in buildings?



.....
.....

(1)

(c) Why are transition metal compounds added to glazes for pottery?



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(1)
(Total 3 marks)

9

Niobium is a typical transition metal.

Put a tick (✓) next to each of the **four** properties in the table that you would expect for Niobium.

Property	
brittle	
conducts heat	
dull	
forms coloured compounds	
high melting point	
low boiling point	
strong	
very reactive	

(Total 4 marks)

10

Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.



- (a) State why transition metal oxides are added to pottery glazes.

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(1)

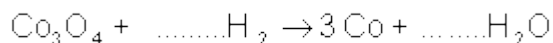
- (b) Use the table of ions on the Data Sheet to help you work out the formula of iron(III) oxide.

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(1)

(c) Cobalt oxide is reacted with hydrogen to form cobalt.

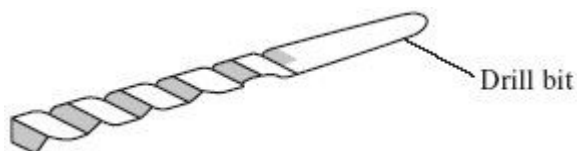
(i) Balance the equation for this reaction.



(1)

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.



Suggest **two** properties of transition metals that make them suitable for making cutting tools.

1

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2

.....

(2)

(Total 5 marks)

11

The extract below was taken from a leaflet on the uses of platinum. One of the uses described was in making electrodes for spark plugs in car engines. The spark plug produces the spark which ignites the fuel in the engine.

Spark Plugs

The electrodes in a spark plug have to conduct electricity very well. Since they project into the combustion chamber of the engine, they must also be able to withstand extremely high temperatures in a very corrosive atmosphere.

Nickel-based plugs have been produced for many years. They only last a fairly short time. As the electrodes wear, combustion becomes less efficient and the petrol is not burnt completely.

Platinum and other precious metals can now be used in spark plugs. These last much longer and are more efficient. This can help to reduce air pollution.

The table below gives some information about platinum and nickel.

	MELTING POINT (° C)	BOILING POINT (° C)	POSITION IN REACTIVITY SERIES	COST (£/kg)
nickel	1455	2920	Higher than gold	2.5
platinum	1769	4107	below gold	6110

- (a) Compare nickel and platinum for use in making the electrodes in spark plugs.

A good answer should give advantages and disadvantages of each metal linking these to the properties of the metals. Marks will be given for the way in which you organise your answer.

You will need a sheet of lined paper.

(8)

- (b) (i) Describe the structure and bonding in metals.

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(3)

- (ii) Explain why metals such as nickel and platinum are good conductors of electricity.

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(2)

(Total 13 marks)

12

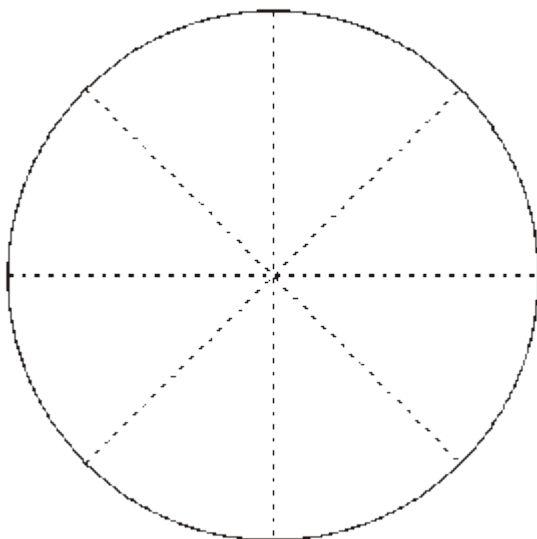
The table shows the % composition by mass of modern British coins.

COIN	% COMPOSITION BY MASS			
	copper	nickel	tin	zinc
£1	70	5.5	–	24.5
20p	84	16	–	–
5p, 10p, & 50p				
1p & 2p (until 1991)	97	–	0.5	2.5
1p & 2p (1992 onwards)	Copper plated steel			

- (a) Use the Data Sheet to help you to complete the table by filling in the information about 5p, 10p and 50p coins which are made of cupronickel.

(1)

- (b) Shade the pie chart to represent the % of copper in a £1 coin.



(1)

- (c) Name the metal present in:

- (i) all these coins,

.....

(1)

- (ii) a £1 coin but **not** in a 20p coin.

.....

(1)

- (d) The following is a list of properties.

- bends easily
- good conductor of electricity
- hard
- high melting point
- poor conductor of heat
- unreactive

From this list, choose two properties which coinage metals should have. For each property, give a reason for your answer.

Property 1

Reason

Property 2

Reason

(2)

(Total 6 marks)

13

- (a) What is the name given to the block of elements in the middle of the Periodic Table which includes vanadium?

.....

(1)

(b) Some of the properties of vanadium are shown in this list.

- It has a high melting point.
- It is a solid at room temperature.
- It is a conductor of electricity.
- It is a good conductor of heat.
- It forms coloured compounds.
- It forms crystalline compounds.
- It forms compounds that are catalysts.

Select **two** properties, from the list above, which are **not** typical of a Group 1 metal.

1

2

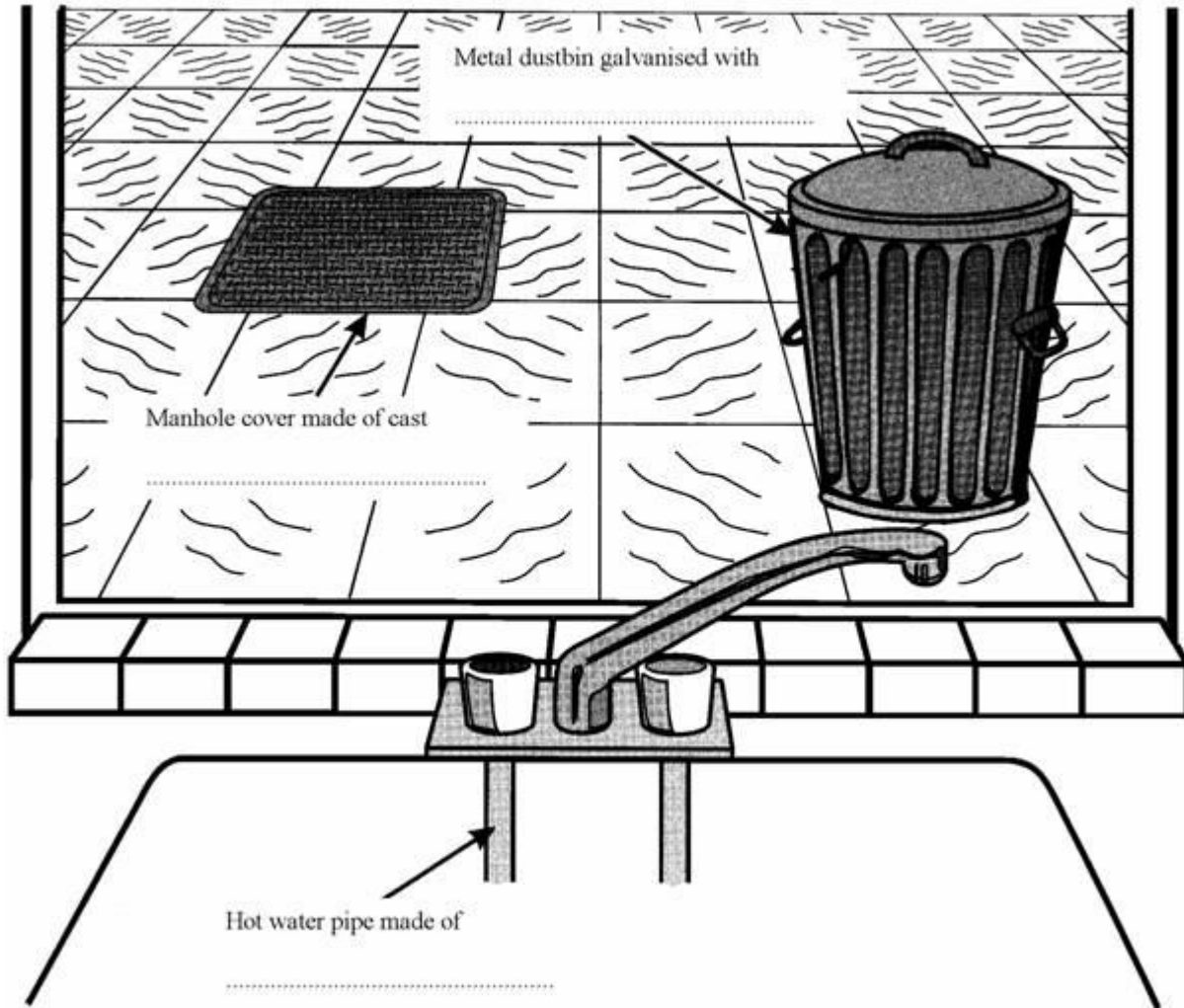
(2)
(Total 3 marks)

14

The word box contains the names of some metals.

aluminium	copper	iron	manganese	zinc
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- (i) The drawing shows the view from a window. Choose from the names of metals in the box to complete the **three** spaces.



(3)

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

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(1)

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

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(1)

(Total 5 marks)