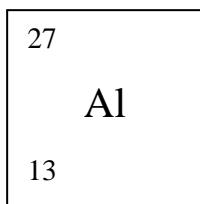


01 This question is about atomic structure.

01.1 An atom of aluminium has the nuclear symbol:



Complete **Table 1** about the subatomic particles in the sodium atom.

[3 marks]

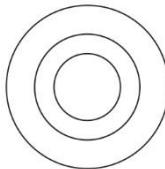
Table 1

Subatomic particle	Number present in the aluminium atom
proton	
neutron	
electron	

01.2 Complete **Figure 1** to show how the electrons are arranged in the aluminium atom.

[1 mark]

Figure 1



Exam Tip

Remember that the electrons fill from the lowest energy level (shell) first, this is nearest the nucleus. The first shell holds a maximum of 2 electrons, the second and third shell each a maximum of 8. After that, the electrons fill the fourth shell.

01.3 Aluminium has two isotopes that occur naturally, ^{27}Al and ^{26}Al .

Which **two** statements are true about isotopes?

[2 marks]

Tick **two** boxes.

isotopes have the same mass number but different atomic number

isotopes have the same atomic number but different mass number

isotopes have the same number of protons but a different number of neutrons

isotopes have the same number of protons but a different number of electrons

isotopes have the same number of neutrons but a different number of protons

01.4 Aluminium is in Group 3 of the Periodic Table. It is a good conductor of electricity and melts at 660.3 °C.

Is aluminium a metal or non-metal?

Circle **one** answer and explain your choice.

[3 marks]

Metal

Non-metal

Explanation: _____

02 This question is about CaCO₃.

02.1 Is CaCO₃ an element, a compound, or a mixture?

[1 mark]

02.2 Give the chemical name for CaCO₃.

[1 mark]

02.3 Give the relative formula mass, Mr, of CaCO₃.

[2 marks]

Relative atomic masses, Ar : C = 12, Ca = 40, O = 16

Mr = _____

- 02.4** CaCO_3 is a solid. When it is heated it breaks down to produce calcium oxide and carbon dioxide. Calcium oxide is a solid.

Complete the following equation by adding in the state symbols.

[1 mark]



- 02.5** When 12.5 g of CaCO_3 is heated, 6.5 g of calcium oxide is produced.

How much carbon dioxide will be formed?

[1 mark]

Mass of carbon dioxide = _____ g

- 02.6** A student heated 12.5 g of CaCO_3 and obtained only 6.37 g of calcium oxide.

Calculate the percentage yield.

[2 marks]

Percentage yield = _____ %



Exam Tip

The percentage yield can never be more than 100%. If it is above 100% check your calculation! Also check that your answer looks right. Hydrogen, for example, is a light element so it is unlikely to be a very high percentage of the total mass.

- 02.7** Calcium oxide reacts with water to form calcium hydroxide solution.

What pH would you expect this solution to have?

[1 mark]

Tick **one** box.

pH 1

pH 5

pH 7

pH 9

- 02.8** Calcium hydroxide has the formula $\text{Ca}(\text{OH})_2$

How many atoms of each element are there in **one** molecule of calcium hydroxide?

[3 marks]

Calcium: _____ atom(s)

Oxygen: _____ atom(s)

Hydrogen: _____ atom(s)

- 03** The Periodic Table arranges elements by their atomic number as well as their properties.

- 03.1** What does the group number tell you about the element?

[1 mark]

- 03.2** What does the period tell you about the element?

[1 mark]

- 03.3** Group 0 elements are called the noble gases.

What properties do these gases have?

[2 marks]

Tick **two** boxes.

The boiling point increases as you go down the group, as the mass increases

The boiling point decreases as you go down the group, as the mass increases

they are all unreactive as the outer shells are full

They all have 8 electrons in their outer shell

They exist as molecules



Exam Tip

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As the atom gets bigger, the forces between the atoms increases –this means it gets harder for the atoms to move away from each other and the boiling point increases.

03.4 Group 7 elements are called the halogens. When they react with metals, they form ionic compounds.

Complete the word equation.

[1 mark]



03.5 Balance the symbol equation for the reaction in **03.4**.

[1 mark]



03.6 Reactivity decreases as you go down Group 7.

Explain why this happens.

[3 marks]



Exam Tip

As the outer shell gets further away from the nucleus, the attractive force of the nucleus decreases so the last electron will not be attracted as easily as it does further up the group.

03.7 Predict the products of the reaction between chlorine and potassium bromide.

Explain your answer.

[4 marks]

Products: _____

Explanation: _____

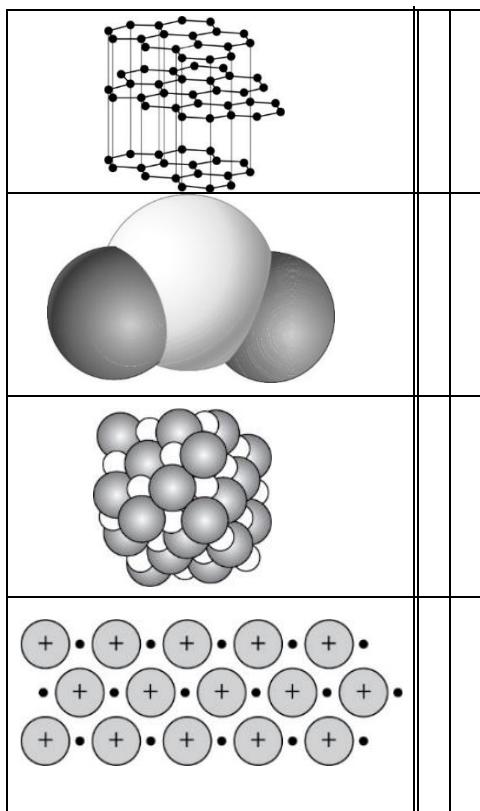
04 This question is about bonding.

04.1 Draw **one** line from each diagram to the type of bonding.

[3 marks]

Diagram

Type of bonding



ionic bonding

metallic bonding

giant covalent substance

simple covalent molecule

04.2 Complete the following sentences.

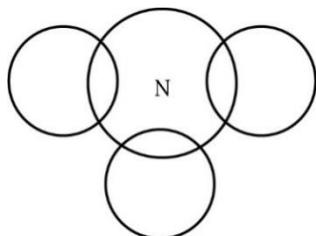
[3 marks]

Covalent bonding involves the _____ of electrons and only occurs between atoms of elements that are _____. These bonds between the atoms are _____.

04.3 Ammonia, NH_3 , is a covalent compound.

Complete the dot-and-cross diagram for NH_3 .

[2 marks]



04.4 Explain why ammonia is a gas at room temperature.

[2 marks]

! Exam Tip

Covalent bonds between the atoms in the molecule are very strong, but the forces between the molecules – the intermolecular forces – are weak.

- 05** A student investigated how different metals reacted with sulfuric acid.

This is the method they used:

- 1 metal to a test tube. Add 1 spatula of
- 2 of sulfuric acid into a measuring cylinder and record the temperature of the acid. Measure 10 cm³
- 3 the metal. Add the acid to
- 4 maximum temperature increase. Record the
- 5 with each different metal. Repeat steps 1-4

Table 2 shows the student's results.

Table 2

Metal	Start temperature in °C	End temperature in °C	Temperature rise in °C
magnesium	21.4	43.9	22.5
copper	21.0	21.5	0.5
aluminium	20.9	37.4	16.5
iron	20.8		5.5
zinc	21.2	30.2	

- 05.1** Calculate the end temperature for iron.

[1 mark]

_____ °C

- 05.2** Calculate temperature rise for zinc.

[1 mark]

_____ °C

- 05.3** This reaction transfers energy to the surroundings. This means that the temperature of the surroundings increases.

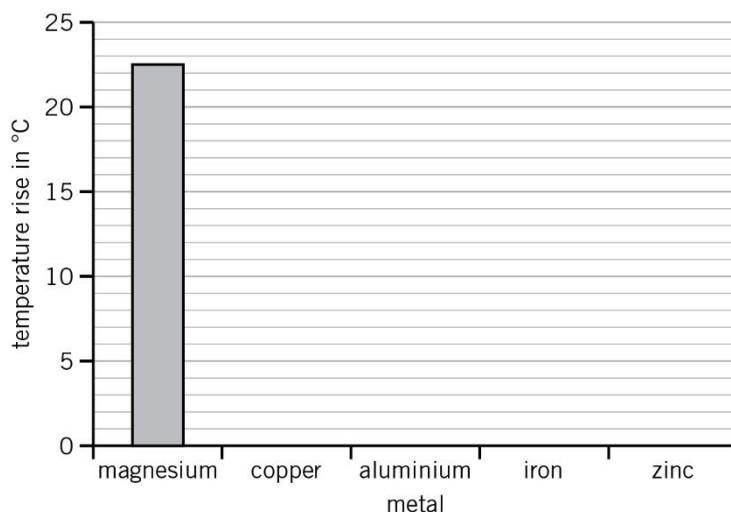
What type of reaction is this?

[1 mark]

- 05.4 Complete **Figure 2** using the data from **Table 1**.

[2 marks]

Figure 2



Exam Tip

Always check your bar heights. You are only allowed ± 1 mm so make sure they are spot on.

- 05.5 Suggest **two** improvements to make the experiment more accurate.

[2 marks]

1 _____

2 _____

- 05.6 What **two** products are made when magnesium reacts with sulfuric acid?

[1 mark]

Tick **one** box.

- Magnesium sulfate + water
- Magnesium sulfate + hydrogen
- Magnesium sulfide + water
- Magnesium sulfide + hydrogen

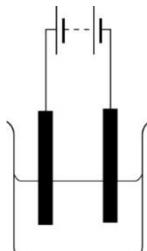
- 05.7 Write the name of the ion that all acids produce in aqueous solution.

[1 mark]

06 This question is about electrolysis.

06.1 Figure 3 shows an electrolysis cell.

Figure 3



Label **Figure 3** using words from the box.

[4 marks]

anode cathode electrolyte d.c. power supply

06.2 The teacher performed electrolysis on two molten compounds: lead bromide, copper chloride, and zinc iodide.

Why must the compounds be molten?

[1 mark]

06.3 Complete **Table 2** and predict what substance will be produced at each electrode after electrolysis. [4 marks]

Table 2

Compound	Anode	Cathode
Lead bromide		
Copper chloride		



Exam Tip

Remember, when the element is formed at the electrode you should be able to find it listed in the Periodic Table – in other words bromine **not** bromide.

06.4 Aluminium is extracted from aluminium oxide by electrolysis. The formula for aluminium oxide is Al_2O_3 .

What is the charge on an aluminium ion?

[1 mark]

Tick **one** box.

Al^{2-}

Al^{2+}

Al^{3+}

Al^{3-}

- 06.5** Aluminium is a very important metal. Electrolysis is an expensive process.

Explain the process of electrolysis of aluminium oxide and include any cost saving measures in the process.

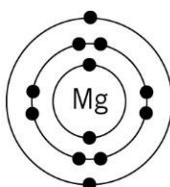
You should also include why the carbon electrodes need to be replaced.

[6 marks]

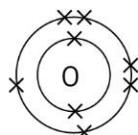
- 07** This question is about ionic compounds.

- 07.1** Magnesium oxide is an ionic compound.

Figure 4



magnesium atom



oxygen atom

Describe, in terms of electrons, the reaction between magnesium and oxygen and name the ions produced including their charge.

[4 marks]



Exam Tip

Remember that when the molecule formed from non-metal elements, change their ending to -ide – in other words oxide ion **not** oxygen ion.

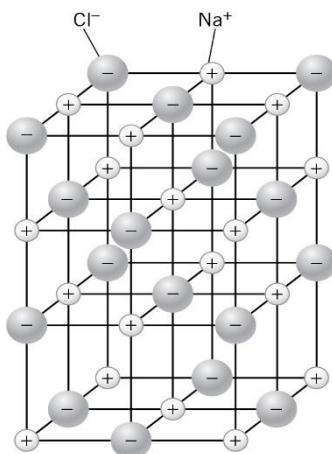
- 07.2** Tick the boxes that apply to ionic substances.

[4 marks]

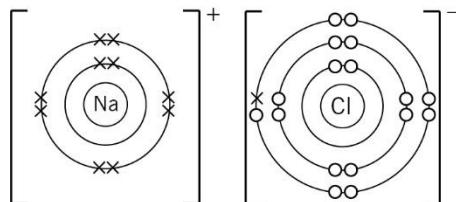
Property	Yes	No
Does it have a high melting point?		
Does it conduct electricity as a solid?		
Is it soluble?		
Does it conduct electricity when dissolved in water?		

- 07.3** Ionic compounds such as sodium chloride can be represented by dot-and-cross diagrams and ball-and-stick models as in **Figure 5**.

Figure 5



Ball-and-stick model



Dot-and-cross diagram

List **one** advantage of the ball-and-stick model compared to the dot-and-cross diagram, and list **one** advantage of the dot-and-cross diagram compared to the ball-and-stick model. [2 marks]

Advantage of ball-and-stick model: _____

Advantage of dot-and-cross diagram: _____

- 08** This question is about neutralisation.

08.1 Complete the general equation for neutralisation.

[2 marks]

acid + alkali → _____ + _____

08.2 When an acid neutralises an alkali, the solution formed is neutral.

What pH value will the neutral solution have?

[1 mark]

Tick **one** box.

pH 2

pH 5

pH 7

pH 1

08.3 Here is a list of equipment:

- burette
- glass pipette
- conical flask
- pipette filler
- white tile

Describe how you would use the equipment to find out how much sodium hydroxide is needed to neutralise 25 cm³ of hydrochloric acid.

Also include what indicator you would use to determine the end point.

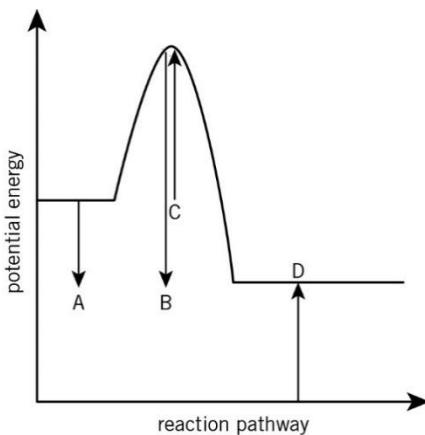
[6 marks]

08.4 Neutralisation reactions release energy to the surroundings.

Identify which arrow (A-D) on **Figure 6** represents the overall energy change of the reaction.

[1 mark]

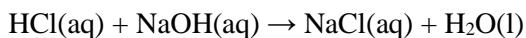
Figure 6



Tick **one** box.

- A**
- B**
- C**
- D**

08.5 When hydrochloric acid is neutralised with sodium hydroxide the following reaction occurs:



Calculate the atom economy of this reaction to produce sodium chloride.

Write your answer to 3 significant figures.

[3 marks]

Relative formula masses, Mr: HCl = 36.5, NaOH = 40, NaCl = 58.5, H₂O = 18

Atom economy = _____ %



Exam Tip

Don't forget to write your answer to the correct number of significant figures – it is an easy mark to gain and even if you have got any of the calculation wrong you will still get the mark for rounding.

08.6 Why is it an advantage to have a high atom economy?

[1 mark]

09 This question is about nanoscience.

09.1 Convert 1 nm into metres and write it in standard form.

[1 mark]

$$1 \text{ nm} = \underline{\hspace{2cm}} \text{ m}$$



Exam Tip

Learn your units – you must know how to convert mm, μm , and nm into m and give your answer in standard form.

09.2 Match the particle sizes with the descriptions.

Each description must match up to a size.

[2 marks]

Particle	Size
nano particles	2500–10000 nm
dust	1–100 nm
fine particles	100–2500 nm

09.3 Why do nanoparticles have different properties to the bulk material?

[1 mark]

09.4 Nanoparticles are used in sun creams as they spread easily and get absorbed into the skin quickly.

Suggest **one** other advantage and one disadvantage of using nanoparticles in sun creams.

[2 marks]

Advantage: _____

Disadvantage: _____