AQA - Reactivity of metals – GCSE Chemistry

1. May/2020/Paper_8462/1F/No.5

   This question is about aluminium.

   Aluminium is a metal.

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

Property	Reason

   Property   **Reason**

   | Aluminium has delocalised electrons |

   | Conducts electricity | | Aluminium has layers of atoms which can slide |

   | Aluminium has strong metallic bonds |

   | High melting point | | Aluminium has weak intermolecular forces |

   | Aluminium has a random arrangement of atoms |

   Aluminium can be used to make alloys.

   What is meant by an 'alloy'?
   [1 mark]

   _____

   _____

Aluminium is extracted from bauxite.

Bauxite is a mixture which contains aluminium oxide.

Bauxite contains between 15% and 25% aluminium.

Aluminium oxide always contains 53% aluminium.

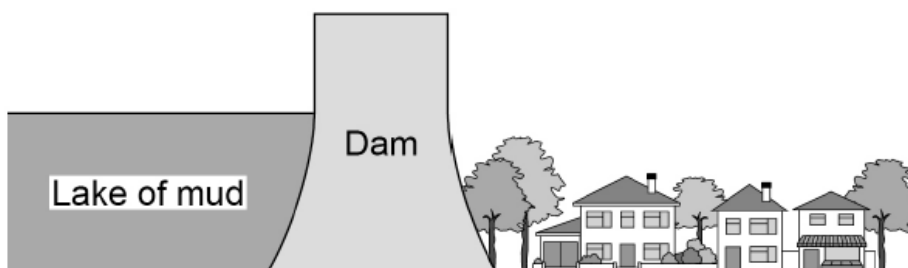How does this show that bauxite is a mixture and **not** a compound?

[1 mark]

_____

_____

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

The lakes of mud are held in place by dams.

Figure 6 shows one of these lakes.

Figure 6

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

[2 marks]

1_____

_____

2_____

_____

Aluminium is extracted by electrolysis.

The aluminium oxide is mixed with cryolite and melted.

The mixture is then electrolysed.

The formula of cryolite is Na_3AlF_6

Give the total number of atoms in the formula.

[1 mark]

Number of atoms = _____

What is the reason for adding cryolite to the aluminium oxide?

[1 mark]

Tick (✓) **one** box.

To increase the amount of aluminium extracted ☐

To lower the melting point of the mixture ☐

To reduce the amount of aluminium oxide needed ☐

Complete the sentences.

Choose answers from the box.

[2 marks]

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

When the molten aluminium oxide and cryolite mixture is electrolysed the product

at the positive electrode is _____.

This product reacts with the positive electrode because the positive electrode is

made of _____.

A sample of bauxite contains 25% aluminium.

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

Give your answer in standard form.

[3 marks]

_____

_____

_____

_____

_____

Maximum mass (in standard form) = _____ kg

2. May/2020/Paper_8462/1F/No.9

This question is about metals and the reactivity series.

Which **two** statements are properties of most transition metals?

[2 marks]

Tick (✓) **two** boxes.

They are soft metals. ☐

They form colourless compounds. ☐

They form ions with different charges. ☐

They have high melting points. ☐

They have low densities. ☐

A student added copper metal to colourless silver nitrate solution.

The student observed:

- pale grey crystals forming

- the solution turning blue.

Explain how these observations show that silver is less reactive than copper.

[3 marks]

_____

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A student is given three metals, **X**, **Y** and **Z** to identify.

The metals are magnesium, iron and copper.

Plan an investigation to identify the three metals by comparing their reactions with dilute hydrochloric acid.

Your plan should give valid results.

[4 marks]

_____

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_____

Metal **M** has two isotopes.

Table 6 shows the mass numbers and percentage abundances of the isotopes.

Table 6

Mass number	Percentage abundance (%)
203	30
205	70

Calculate the relative atomic mass (A_r) of metal **M**.

Give your answer to 1 decimal place.

[2 marks]

_____

_____

_____

_____

Relative atomic mass (1 decimal place) = _____

3. May/2020/Paper_8462/1H/No.2

This question is about metals and the reactivity series.

Which **two** statements are properties of most transition metals?

[2 marks]

Tick (✓) **two** boxes.

They are soft metals. ☐

They form colourless compounds. ☐

They form ions with different charges. ☐

They have high melting points. ☐

They have low densities. ☐

A student added copper metal to colourless silver nitrate solution.

The student observed:

- pale grey crystals forming
- the solution turning blue.

Explain how these observations show that silver is less reactive than copper.

[3 marks]

_____

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A student is given three metals, **X**, **Y** and **Z** to identify.

The metals are magnesium, iron and copper.

Plan an investigation to identify the three metals by comparing their reactions with dilute hydrochloric acid.

Your plan should give valid results.

[4 marks]

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Metal **M** has two isotopes.

Table 2 shows the mass numbers and percentage abundances of the isotopes.

Table 2

Mass number	Percentage abundance (%)
203	30
205	70

Calculate the relative atomic mass (A_r) of metal **M**.

Give your answer to 1 decimal place.

[2 marks]

_____

_____

_____

_____

Relative atomic mass (1 decimal place) = _____

4. May/2020/Paper_8462/1H/No.6
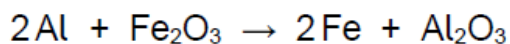This question is about displacement reactions.

The displacement reaction between aluminium and iron oxide has a high activation energy.

What is meant by 'activation energy'?

[1 mark]

_____

_____

A mixture contains 1.00 kg of aluminium and 3.00 kg of iron oxide.

The equation for the reaction is:

$$2\,Al \; + \; Fe_2O_3 \; \rightarrow \; 2\,Fe \; + \; Al_2O_3$$

Show that aluminium is the limiting reactant.

Relative atomic masses (A_r):   O = 16   Al = 27   Fe = 56

[4 marks]

_____

_____

_____

_____

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_____

Magnesium displaces zinc from zinc sulfate solution.

Complete the ionic equation for the reaction.

You should include state symbols.

[2 marks]

$$Mg(s) + Zn^{2+}(aq) \rightarrow \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$$

Explain why the reaction between magnesium atoms and zinc ions is both oxidation and reduction.

[2 marks]

_____

_____

_____

_____

5. May/2020/Paper_8462/1H/No.8.5

Explain why the reactivity of the halogens decreases going down the group.

[3 marks]

_____

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_____

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6. May/2019/Paper_8462/1F/No.4.2

Write the three metals used for electrode **X** in order of reactivity.

Use **Table 1**.

[1 mark]

Most reactive _____

_____

Least reactive _____

May/2019/Paper_8462/1F/No.4.2
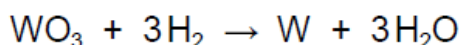
7. May/2019/Paper_8462/1F/No.6-6.5

This question is about the extraction of metals.

Tungsten is a metal.

The symbol of tungsten is W

Tungsten is produced from tungsten oxide by reaction with hydrogen.

The equation for the reaction is:

$$WO_3 + 3H_2 \rightarrow W + 3H_2O$$

Calculate the percentage atom economy when tungsten is produced in this reaction.

Use the equation:

$$\text{percentage atom economy} = \frac{184}{(M_r\ WO_3) + (3 \times M_r\ H_2)} \times 100$$

Relative formula masses (M_r): $WO_3 = 232$ $H_2 = 2$

[2 marks]

_____

_____

_____

_____

Percentage atom economy = _____ %

Aluminium is extracted from aluminium oxide.

38% of a rock sample is aluminium oxide.

Calculate the mass of aluminium oxide in 40 kg of the rock sample.

[2 marks]

_____

_____

_____

_____

Mass of aluminium oxide = _____ kg

The formula of aluminium oxide is Al_2O_3

Calculate the relative formula mass (M_r) of aluminium oxide.

Relative atomic masses (A_r):   O = 16   Al = 27

[2 marks]

_____

_____

_____

_____

Relative formula mass (M_r) = _____

60.0 kg of aluminium oxide produces a maximum of 31.8 kg of aluminium.

In an extraction process only 28.4 kg of aluminium is produced from 60.0 kg of aluminium oxide.

Calculate the percentage yield.

Give your answer to 3 significant figures.

Use the equation:

$$\text{percentage yield} = \frac{\text{mass of product actually made}}{\text{maximum theoretical mass of product}} \times 100$$

[3 marks]

_____

_____

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Percentage yield = _____ %

Extracting metals by electrolysis is a very expensive process.

Explain why aluminium is extracted using electrolysis and not by reduction with carbon.
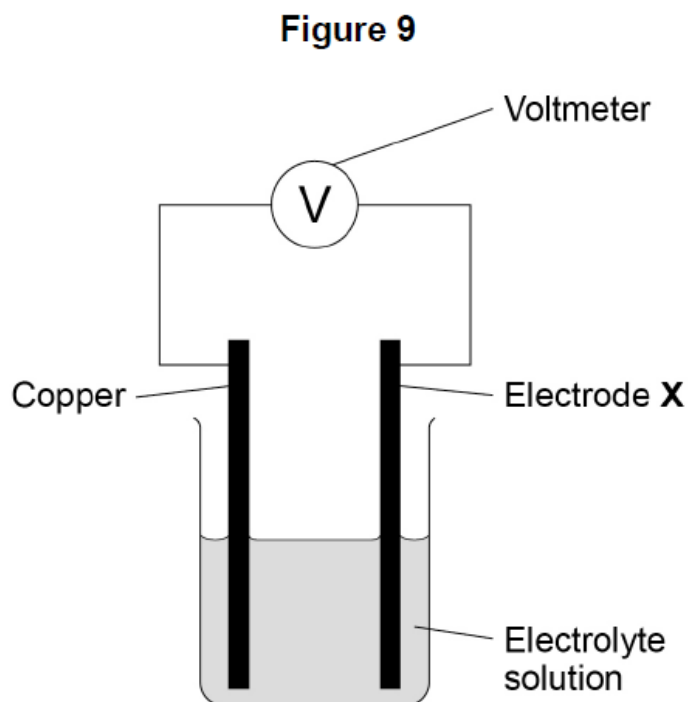
[2 marks]

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8. May/2019/Paper_8462/1H/No.6
This question is about chemical cells.

A student investigated the voltage produced by different chemical cells.

Figure 9 shows the apparatus.

Figure 9

This is the method used.

1. Use cobalt as electrode **X**.

2. Record the cell voltage.

3. Repeat steps 1 and 2 using different metals as electrode **X**.

Suggest **two** control variables used in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

Table 4 shows the student's results.

Table 4

Electrode X	Voltage of cell in volts
cobalt	+0.62
copper	0.00
magnesium	+2.71
nickel	+0.59
silver	−0.46
tin	+0.48

Write the six metals used for electrode **X** in order of reactivity.

Use **Table 4**.

Justify your order of reactivity.

[4 marks]

Most reactive _____

_____

_____

_____

_____

Least reactive _____

Justification _____

_____

_____

_____

_____