AQA GCSE Chemistry

Quantitative chemistry · Higher tier

Questions only

The newest questions on the Higher papers, about an hour. All 6 are in the exam generator.

Questions	Total marks	Time allowed
5	**55**	**58 min**

Name _____ Class or teacher _____ Date _____

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the periodic table insert.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2023 P1H Q10	8	
2	2024 P1H Q7	15	
3	2025 P1H Q3 / P1F Q10	11	
4	2025 P1H Q9	11	
5	2021 P1H Q3 / P1F Q10	10	

Total _____ / 55 **Percentage** _____ %

Questions from AQA GCSE past papers, 2021–2025, reproduced for revision. Practise these topics online, with instant marking:
`whiteboardchemistry.com/revision/gcse-chemistry/exam-questions?topics=c3-quantitative-chemistry&demand=standard,high&len=0`

Questions

Quantitative chemistry · Higher tier · 5 questions · 55 marks · time allowed 58 min

Q1 · June 2023 · Paper 1 Higher · Q10 · [8 marks]

This question also needs Bonding, structure, and the properties of matter.

This question is about titanium dioxide (TiO_2).

10.1 Self-cleaning windows are coated with a layer of nanoparticles of titanium dioxide.

Titanium dioxide:

- helps sunlight break down dirt particles
- attracts water, so dirt is washed away by rain.

Nanoparticles of titanium dioxide are used instead of fine particles of titanium dioxide for coating self-cleaning windows.

Suggest **two** reasons why.

[2 marks]

1

2

10.2 Titanium is extracted from titanium dioxide in a two-stage process.

The equation for the first stage in the process is:

$TiO_2 + 2Cl_2 + 2C \rightarrow TiCl_4 + 2CO$

Calculate the volume of chlorine gas needed to react completely with 100 kg of titanium dioxide.

Relative atomic masses (A_r): O = 16 Ti = 48

The volume of one mole of gas = 24 dm^3

Volume = _____ dm^3

[6 marks]

Q2 · June 2024 · Paper 1 Higher · Q7 · [15 marks]

This question also needs Bonding, structure, and the properties of matter.

This question is about iron.

07.1 Iron is a metal.

Describe how iron conducts thermal energy.

[2 marks]

07.2 Pure iron is too soft for many uses.

Explain why mixing iron with other metals makes alloys which are harder than pure iron.

[3 marks]

07.3 When iron reacts with chlorine, 0.12 mol of iron reacts with 0.18 mol of chlorine (Cl_2).

Which is the correct equation for the reaction?

Tick (✓) **one** box.

$Fe + Cl_2 \rightarrow FeCl_2$	☐
$Fe + 3Cl_2 \rightarrow FeCl_6$	☐
$2Fe + Cl_2 \rightarrow 2FeCl$	☐
$2Fe + 3Cl_2 \rightarrow 2FeCl_3$	☐

[1 mark]

07.4 The most common oxides of iron are Fe_2O_3 and Fe_3O_4

What is the ratio of the numbers of ions in Fe_3O_4?

Tick (✓) **one** box.

2 Fe^{2+} : 1 Fe^{3+} : 4 O^{2-}	☐
1 Fe^{2+} : 2 Fe^{3+} : 4 O^{2-}	☐
3 Fe^{2+} : 4 O^{2-}	☐
3 Fe^{3+} : 4 O^{2-}	☐

[1 mark]

07.5 Calculate the percentage (%) by mass of iron in Fe_3O_4

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

Percentage by mass of iron = _____ %

[3 marks]

07.6 Fe_2O_3 reacts with carbon to produce carbon dioxide.

The equation for the reaction is:

$2Fe_2O_3(s) + 3C(s) \rightarrow 4Fe(s) + 3CO_2(g)$

Calculate the volume of carbon dioxide gas at room temperature and pressure that is produced from 40.0 kg of Fe_2O_3 using excess carbon.

Relative formula mass (M_r): Fe_2O_3 = 160

The volume of 1 mole of any gas at room temperature and pressure is 24 dm^3.

Volume of carbon dioxide = _____ dm^3

[5 marks]

Q3 · June 2025 · Paper 1 Foundation · Q10 · Paper 1 Higher · Q3 · [11 marks]

This question also needs Atomic structure and the periodic table and Chemical changes.

This question is about metals and metal oxides.

Tin (Sn) is extracted from tin oxide using carbon.

The equation for the reaction is:

$SnO_2 + C \rightarrow Sn + CO_2$

10.1 Which substance is reduced in this reaction?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced

Reason

10.2 Why can carbon be used to extract tin from tin oxide?

[1 mark]

10.3 Cadmium (Cd) can be extracted by the reaction of cadmium oxide with carbon.

The equation for the reaction is:

$CdO + C \rightarrow Cd + CO$

Calculate the percentage atom economy for the production of cadmium in this reaction.

Relative atomic masses (A_r): C = 12 Cd = 112

Relative formula mass (M_r): CdO = 128

Percentage atom economy = _____ %

[3 marks]

10.4 Tungsten is a transition metal.

Potassium is a Group 1 metal.

Give **two** differences between the properties of tungsten and the properties of potassium.

[2 marks]

1

2

10.5 Tungsten oxide reacts with hydrogen to give tungsten (W) and water.

The equation for the reaction is:

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

The law of conservation of mass states:

'The mass of the products equals the mass of the reactants during a chemical reaction.'

Show that the equation obeys the law of conservation of mass.

Relative atomic mass (A_r): W = 184

Relative formula masses (M_r): H_2 = 2 WO_3 = 232 H_2O = 18

[2 marks]

10.6 The reaction producing tungsten has a high atom economy.

Why is it important to use reactions with a high atom economy in industry?

[1 mark]

Q4 · June 2025 · Paper 1 Higher · Q9 · [11 marks]

This question also needs Atomic structure and the periodic table and Chemical changes.

Zinc reacts with iodine to produce the salt zinc iodide.

The reaction is done in a solution using ethanol as the solvent.

Ethanol is a flammable liquid with a boiling point of 78 °C.

Table 5 shows the solubility of zinc, iodine and zinc iodide in ethanol.

Table 5

	Zinc	Iodine	Zinc iodide
Solubility in ethanol	Insoluble	Soluble	Soluble

09.1 Plan a method to obtain crystals of zinc iodide from zinc and iodine.

[6 marks]

09.2 A student used 6.35 g of iodine in the reaction.

6.29 g of zinc iodide was produced.

The equation for the reaction is:

$Zn + I_2 \rightarrow ZnI_2$

Calculate the percentage yield of zinc iodide.

Give your answer to 3 significant figures.

Relative formula masses (M_r): $I_2 = 254$ $ZnI_2 = 319$

Percentage yield (3 significant figures) = _____ %

[5 marks]

Q5 · November 2021 · Paper 1 Foundation · Q10 · Paper 1 Higher · Q3 · [10 marks]

This question also needs Atomic structure and the periodic table and Chemical changes.

This question is about the extraction of metals.

Element R is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:

$3H_2 + RO_3 \rightarrow R + 3H_2O$

10.1 The sum of the relative formula masses (M_r) of the reactants ($3H_2 + RO_3$) is 150

Calculate the relative atomic mass (A_r) of R.

Relative atomic masses (A_r): H = 1 O = 16

Relative atomic mass (A_r) of R = _____

[2 marks]

10.2 Identify element R.

You should use:

- your answer to question 10.1
- the periodic table.

Identity of R = _____

[1 mark]

10.3 Carbon is used to extract tin (Sn) from tin oxide (SnO_2).

The equation for the reaction is:

$SnO_2 + C \rightarrow Sn + CO_2$

Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses (A_r): C = 12 O = 16 Sn = 119

Percentage atom economy = _____ %

[3 marks]

10.4 Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide (WO_3).

All other solid products from the extraction method must be separated from the tungsten.

Table 9 shows information about three possible methods to extract tungsten from tungsten oxide.

Table 9

Method	Reactant	Relative cost of reactant	Products
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

Evaluate the three possible methods for extracting tungsten from tungsten oxide.

[4 marks]

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Mark scheme:
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