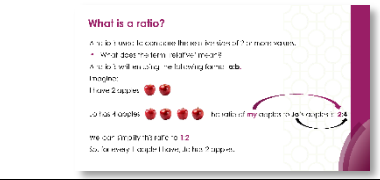
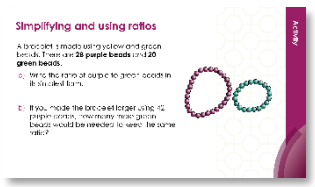
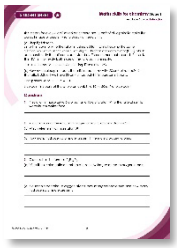
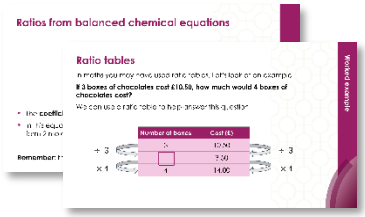
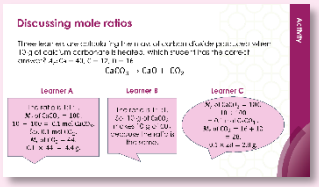
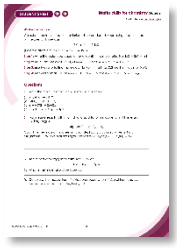
Ratio and proportion

This set of activities forms part of the Maths skills for chemistry resources series which can be viewed at: rsc.li/4A41ezG. The series offers flexible, targeted support for maths skills which are fundamental to chemistry teaching:

- Graphs and data, divided into:
    - Creating graphs
    - Interpreting graphs
- **Ratio and proportion**
- Understanding number, divided into:
    - Unit conversion
    - Significant figures and rounding
- Algebra and equations

Resource series components

The resource series is divided into two stages. Stage 1 (✪) is most suitable for ages 11–14 and stage 2 (✪✪) for ages 14–16. However, older learners with gaps in their fundamental knowledge can use stage 1 as a stepping stone.

Stage 1 ✪		
		
Teacher-led presentation (✪)	**Short activities (✪)**	**Learner worksheet (✪)**
Stage 2 ✪✪		
		
Teacher-led presentation (✪✪): a full lesson including learning objectives, learner-facing instructions and activities.	**Short activities (✪✪):** learner-facing activities, designed as lesson starters or quick activities to engage prior knowledge.	**Learner worksheet (✪✪):** activities for learners to independently practice their maths skills. Suitable as classroom activity following the teacher presentation or as a home-learning task.

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Key terms support

Key vocabulary for each skill area is defined in the key terms support: rsc.li/4wypuqq. You will find the key terms listed by topic area and an accessible glossary slide for each term.

Using the short activities presentation

The aim of this resource is for learners to revisit and practise skills from the teacher-led presentation and to develop problem solving skills so they can apply these independently.

Learning objectives

1 Use ratios from balanced symbol equations to determine quantities of reactants and products.

2 Calculate and use mole ratios from chemical equations.

As you move through the activities, there is a clear progression in skill development. The first activity or activities engage learners' prior knowledge of the chosen maths skill. Following this, learners will complete activities within a chemistry context.

Activities can be teacher-led, for learners requiring additional support or modelling, or can be set as independent work.

The presentation contains five short activities that are designed to last 5–15 minutes and to be used as:

- a starter activity to engage prior knowledge or to practise a skill
- an assessment tool, used at the beginning of a lesson or sequence of work
- as follow-up independent practice during lessons or plenary
- for retrieval practice.

Metacognition

The learner worksheet supports learners to develop their metacognitive skills in three key areas.

- **Planning** – prompt learners to draw on their existing mathematical knowledge by asking themselves: 'Have I seen a similar question before? Have I come across this mathematical skill before? Have I learned a different method for solving a similar problem?'
- **Monitoring** – prompt learners to ask themselves: 'How confident am I feeling with these mathematical skills? Which questions am I finding difficult? Which type of questions do I feel I have mastered?'
- **Evaluation** – prompt learners to ask themselves: 'What have I learned about myself when doing these questions? Which of the mathematical skills did I use to answer these questions?'

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Slide notes

Slide 1: Title slide

No notes.

Slide 2: Introduction

No notes.

Slide 3: Reading mole ratios

Learners can use ratio tables to find the answers. See slides 12–14 in the teacher-led presentation for guidance on how to use ratio tables: rsc.li/4zsNyho.

Slide 4: Reading mole ratios (answers)

No notes.

Slide 5: Calculating masses from equations

A step-by-step answer for each of these parts is shown over the next three slides. See slides 15–17 in the teacher-led presentation for modelling and guidance on teaching this process: rsc.li/4zsNyho.

Slide 6–8: Calculating masses from equations (answers)

No notes.

Slide 9: Calculating masses

This is an example of a non 1:1 ratio. Part (a) simplifies to a 1:1 ratio ($2\mathrm{Al} \rightarrow 2\mathrm{Fe}$), so learners may find it straightforward. Part (b) is where the non 1:1 ratio appears ($\mathrm{Al}:\mathrm{Fe_2O_3} = 2:1$). Learners must identify which pair of substances they are working with and select the correct ratio each time – not just use the same ratio for every part of the question.

Slide 10–11: Calculating masses (answers)

No notes.

Slide 12: Working backwards from the product

This question is different because learners are starting with the product and working back to find the reactant. Many learners assume they always start with a reactant. Stress that the four–step method works in either direction – you always start with the substance you have information about.

Slide 13: Working backwards from the product (answer)

In Step 3, learners need to think carefully about which way to scale. The ratio $\mathrm{N_2}:\mathrm{NH_3}$ = 1:2. They know the $\mathrm{NH_3}$ side (0.2 mol, which represents the '2' in the ratio),

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so they divide by 2 to find N_2. A common error is multiplying by 2 instead – this would give 0.4 mol, leading to a mass of 11.2 g, which is more than the 3.4 g of product.

Learners should recognise that needing more nitrogen than the ammonia produced doesn't make chemical sense, since some of the mass of ammonia comes from the hydrogen as well.

Slide 14: Discussing mole ratios

No notes.

Slide 14: Discussing mole ratios (answer)

Learner B assumes that a 1:1 mole ratio means the masses are equal. This is the most fundamental misconception in mole ratio calculations. A 1:1 ratio means equal moles, not equal masses. 0.1 mol $CaCO_3$ has a mass of 10 g, but 0.1 mol of CO_2 has a mass of only 4.4 g because they have different relative formula masses (100 vs 44).

We can also check using conservation of mass: if 10 g of $CaCO_3$ produced 10 g of CO_2, the mass of CaO would have to be 0 g, which is clearly impossible.

Learner C follows the correct method but makes an error calculating the M_r of CO_2. They write $M_r = 12 + 16 = 28$, but CO_2 contains two oxygen atoms, not one. The correct calculation is $M_r = 12 + (2 \times 16) = 12 + 32 = 44$.

This is a procedural error rather than a conceptual one. The subscript 2 in CO_2 means there are two oxygen atoms, so oxygen's contribution to the M_r must be $2 \times 16 = 32$, not just 16. This is the same type of error as learner C on the teacher-led discussion slide, where the M_r of CH_4 was calculated incorrectly. Learners who rush through M_r calculations are particularly prone to this. Encourage learners to write out the full calculation showing the number of each atom multiplied by its A_r.

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