

## Chapter 3 Ratio and proportion

### Specification

**FS coverage and range** Understand, use and calculate ratio and proportion, including problems involving scale

**FS exemplification** Write a ratio in its simplest form ( $a:b$ )  
Scale quantities up or down  
Calculations with ratios as one unit to another unit scale  
Use map scales in diagrams  
Simple direct and inverse proportion  
Writing fractions as ratios

### GCSE

**GCSE specification**

- N n** Understand and use direct and indirect proportion
- N p** Use ratio notation, including reduction to its simplest form and its various links to fraction notation
- N t** Divide a quantity in a given ratio
- GM m** Use and interpret maps and scale drawings

**Edexcel GCSE course**

**Specification A:**  
**Foundation** 7.9, 24.1–24.4  
**Higher** 12.6, 16.1–16.5

**Specification B:**  
**Foundation Unit 1:** 5.9; **Unit 2:** 6.1–6.4; **Unit 3:** 7.7  
**Higher Unit 1:** 5.9; **Unit 2:** 6.1–6.3; **Unit 3:** 1.2, 14.7

### Resources

**General resources** Playing cards  
Food packaging with nutritional information

**Resource sheets** 3.1, 3.2, 3.3

**Links** <http://news.bbc.co.uk/sport>  
<http://www.bbc.co.uk/food/recipes/>  
<http://www.ordnancesurvey.co.uk>

**ActiveTeach resources** Video  
ResultsPlus Knowledge Check  
ResultsPlus Problem Solving  
Question Audio  
Animations

## Lesson 1

### Objectives

- Find and express numbers as ratios in their simplest form
- Divide quantities into a given ratio
- Make decisions using proportion

### Starter

- Show students eight ratios that can be simplified and ask them to choose six to write in a 'bingo' grid. Show each of the eight ratios in simplified form one by one. Ask students to cross off their equivalent ratios until one individual has a 'full house'.

### Main teaching and learning

- To review the relationship of ratio to fractions and immediately address likely misconceptions, use a recent football result with relevance to students. In particular:
  - Discuss the importance of the order of the numbers in the ratio
  - Consider the fraction of the total goals scored by each team
  - Give the total goals scored by one team as a fraction of the total goals and ask students to write the fraction as a ratio.

Give pairs of students a set of 20 (or other multiple of 5) playing cards and ask them to deal the cards between them in various ratios (e.g. 2:3) without counting the cards first. Discuss the strategies used and how many cards each student ended up with. Ask: *How can you calculate how many cards each person should have once you know how many cards there are? What fraction of the cards does each person have? What would it be fair to do if there was a spare card?*

- Relate this activity to *Take a look*: Pocket money (p33).
- Ask students to complete *Have a go* Q1–3.

### Issues and misconceptions

- Ensure that students always write ratios in the correct order.
- Ensure that students relate the ratio 2:3 to the fraction  $\frac{2}{5}$  rather than to  $\frac{2}{3}$ , for example.
- In Q1, ensure that students calculate the total amount of juice required first. In Q3, note the need for sensible rounding.

### Support

- To provide scaffolding for Q1, ask: *How much juice does Shelley need altogether? How many millilitres is  $\frac{1}{5}$  of a litre?*

### Extension

- Introduce the use of three-part ratios during the Starter and card-sharing activity.
- Relate Q3 to larger scale stratified sampling methods.

### Plenary

- As a class, rewrite Q1–3 as simply as possible. (Q1 becomes 'Share 24 in the ratio 5:3'.)
- Work the other way, making up real-life scenarios that give similar basic questions.

### Formative assessment

- Mark students' numerical answers to Q1–3, then discuss the validity of alternative answers for Q3. Emphasise the need for rounding.

### Homework

- Students find a recipe for at least two people using at least four ingredients (for Lesson 2).
- Ask students to find a nutritional information panel from a food product (for Lesson 3).

## Lesson 2

### Objectives

- Find proportional relationships in questions
- Use ratios to scale quantities up or down
- Calculate missing values in proportional relationships
- State any assumptions made in order to justify answers

### Starter

- Show the class a recipe for four people. Use the recipes found by students as Homework for Lesson 1 or the pancake recipe on Resource sheet 3.1. Ask students to find the quantity of an ingredient that would be required to serve different numbers of people.

### Main teaching and learning

- Share and discuss the methods used during the Starter activity. Consider different methods for scaling up and down and how the unitary method (finding the quantity for one person first) could be used. Link this to the method used in *Take a look: Calories* (p35), where calories per 100 g are used to build up to a solution.
- Tell students that they are going to compare two netball goal shooters. Player A scored 4 and missed 6, Player B scored 3 and missed 5. Students should represent these results using ratios and decide who is the better goal shooter. Discuss the use of fractional equivalents to compare and then scale up to decide how many goals each player would be expected to score in 40 attempts.
- Introduce the use of ratios in the form  $1:n$  in the context of map scales and relate to enlargement and scale factors.
- Emphasise the need for consistent units when writing a ratio. Demonstrate that '2 cm represents 1 km' is the same as the scale 1:50 000.
- Give students the map scale sorting cards from Resource sheet 3.2. These show scales with mixed units. Ask students to sort them into two groups (1:50 000 and 1:25 000) in pairs or small groups. Show students examples of local maps with 1:50 000 and 1:25 000 scales using [www.ordnancesurvey.co.uk](http://www.ordnancesurvey.co.uk).
- Ask students to complete *Have a go* Q4–6.

### Issues and misconceptions

- Encourage students to think about the size of the answer they expect (greater or less than the original quantity) to help them decide whether they need to multiply or divide.

### Support

- Encourage students to work in two stages, using a unitary method to build up an answer.

### Extension

- Ask students to design a spreadsheet that they can use to calculate recipe quantities, as in the Starter, or Bhavna's expenditure for different journey types (Q4).

### Plenary

- Ask: *How many 250 g single serving packs can be produced using 6 kg of chicken casserole?* Investigate how increasing portion size will affect number of packs produced.

### Formative assessment

- Mark students' numerical answers to Q4 and Q5. Ask students to work in pairs to identify all the separate operations used and assess how clearly they are shown in their working.

### Homework

- Students use a route planner website to find the distance they travel to school or college and to calculate the distance in cm this would be on 1:50 000 and 1:25 000 scale maps.

## Lesson 3

### Objectives

- Find and process information from questions to write ratios
- Find and use ratios to solve problems
- Find and use proportional relationships to scale quantities up or down
- Calculate missing values in proportional relationships
- Interpret answers and form conclusions
- State any assumptions made to justify solutions

### Starter

- Show nutritional information for at least two food items. Use information found by students as Homework for Lesson 1 or the data provided on Resource sheet 3.3. Ask students to identify similarities and differences between the two items. Highlight the common use of 'per serving' and 'per 100 g' on nutritional information panels.

### Main teaching and learning

- Divide students into pairs and give each pair some food packaging. Ask students to take it in turns to cover up one value in either the 'per serving' or 'per 100 g' section of the information. Their partner has to work out the missing value from the visible information.
- Show students the nutritional information panel from a packet of biscuits or similar. Tell students the pack size in grams for the biscuits and ask them to calculate the number of biscuits in the pack. Discuss the information they will use and the order in which they will do various calculations using proportion. Emphasise the variety of routes to a correct solution and the reasons why an exact integer answer may not occur.

Relate this activity to *Take a look: Planning a camping trip* (p38). Emphasise the assumptions that have been made about the amount eaten and prices. Ask:

*What assumptions have been made? Why may these assumptions be invalid? How could the result be adjusted to take account of the assumptions?*

- Ask students to complete *Have a go* Q7 and Q8.

### Issues and misconceptions

- Ensure that students understand that a multiplier must never be added or subtracted to scale between quantities. If they are uncertain whether to multiply or divide, they should consider the relative size of a sensible answer.

### Support

- In Q7, students can introduce numbers immediately, thinking about the minimum £500 bonus and then building up to a more general solution.

### Extension

- Ask students to reconsider *Take a look: Planning a camping trip*, given different percentage price increases for different foodstuffs.
- Encourage students to use algebraic notation in Q7.

### Plenary

- Prices in supermarkets are often given per 100 g. Ask: *Will larger quantities always be proportionally cheaper than smaller? Is it always the best option to buy the cheapest?*

### Formative assessment

- Ask students to mark each other's numerical answers and peer-assess the reasoning and assumptions made.

### Homework

- Ask students to find out prices for at least six different pack sizes of cola drink (bottles, cans, multi-packs, etc.) and rank them in order of value for money.