Chapter

5

Ratio and proportion

Specification references: HA4.1, 4.2

EFM All exercises in this chapter

Resources required None

This chapter is about

- Understanding ratio and its notation
- Reducing a ratio to its lowest terms
- Writing a ratio in the form 1 : *n*
- Using ratios in proportion calculations
- Dividing a quantity in a given ratio
- Comparing proportions

Students should already know

- How to multiply and divide without a calculator
- How to find common factors
- How to simplify fractions
- What is meant by an enlargement
- How to change between metric units

General notes

The main purpose of this chapter is to make students aware of what a ratio is and how to use ratios to keep or share quantities in proportion.

It is important to stress that, as a general rule, the parts must be in the same units and a ratio does not contain units. However, in some cases it is appropriate to use a ratio with different units. This is often the case with maps, as in Example 5.7, where the ratio given is 1 cm : 2 km and centimetres and kilometres are both used throughout. This ratio is equivalent to 1 : 200 000, as demonstrated in Challenge 5.2, but 1 cm : 2 km is much easier to work with because the calculations are less complex. When asked to write a ratio in its lowest terms, however, students should always make sure the units of both parts are the same. The less able may benefit from revision of conversion between linear metric units.

All the calculations involving ratios in this chapter entail finding a multiplier. Stress that, when the multiplier is not a whole number, it is best to leave it as a decimal or fraction and round the final answer if necessary. The use of a table, as in Example 5.10, may help some students, but will not be needed by the more able.

Other methods, such as the unitary method, can be used to solve ratio problems instead. However, the unitary method can lead to a wrong answer when the unitary value is not an exact amount.

The final section of the chapter deals with 'best value'. This can be found in many ways: the two demonstrated in the text are comparing the cost per unit mass or volume and comparing the amount per penny or pound. Make sure students realise that they need to use only one method for each question. Again, the use of a table will help some students, but will be unnecessary for others.

Notes on the tasks

Check up 5.1

(a) 1 : 2 **(b)** 5 : 3 : 4

Challenge 5.1

(a) The two quantities have different units.

(b) 1 : 3
Remind any student who gives 1 : 5 as the answer to part **(b)** that there are 60 minutes in an hour, not 100.

Challenge 5.2

The answer to Example 5.7 part **(a)** would be 1 080 000 cm.
You could use the ratio 1 : 200 000 to work this out.

This is the ratio 1 cm : 2 km converted into centimetres.

Discovery 5.1

(a) (i) 50 **(ii)** 20 **(iii)** 30

(b) (i) 75 **(ii)** 30 **(iii)** 45

In each case, the answer to part **(i)** is the sum of the answers to parts **(ii)** and **(iii)**.

In each case, you multiply the total number of sweets in one party bag, the number of lemon sweets in one party bag and the number of raspberry sweets in one party bag by the same number.

This task demonstrates the fact that the same multiplier is used to find each of the parts and the total. As an extension, you could ask students how many party bags Maya can make if she has 125 sweets in total (125 ÷ 5 = 25), and how many are lemon and how many raspberry (25 × 2 = 50 lemon sweets; 25 × 3 = 75 raspberry sweets).

Challenge 5.3

(a) The ratio of width : length for each size of photograph are as follows.
13 cm : 17 cm 1 : 1.308 (to 3 d.p.)
24 inch : 32 inch 1 : 1.333 (to 3 d.p.)
20 inch : 26.5 inch 1 : 1.325
The proportions of the 20 inch by 26.5 inch are closer to the proportions of the original photo.

(b) Okera might choose the other size because there is very little difference in the proportions and he might want the bigger one.

Some students may approach the problem by working out the ratio of the width of the original photo to the width of each of the two enlargements and then applying these ratios to the length of the original photo to find out what it would be if it was enlarged by the same proportion as the width (or vice versa). This method will produce the correct answer, but comparing the width : length ratios for each size of photograph is much simpler, and does not involve changing the units.

Discovery 5.2

The larger packet of cornflakes is the better value for money.

Which packet is the better value can be determined in various ways. Since the larger packet contains three times as many cornflakes as the smaller packet, the most obvious is to multiply the price of the smaller packet by three and see that the answer is greater than £4.99.

However, students may come up with other strategies and this task could be carried out as a class exercise. Hopefully, many students will be able to tell you which packet is the better value, and why. This should lead to a discussion about the most effective methods, and the fact that, to compare value, you must either compare how much you get for a certain amount of money or how much a certain quantity (in this case, mass) costs.

Answers to Chapter 5

Exercise 5.1 (page 63)

1 **(a)** 2 : 1 **(b)** 1 : 3 **(c)** 5:1
(d) 1 : 3 : 5 **(e)** 3 : 6 : 4
2 **(a)** 1 : 20 **(b)** 3 : 20 **(c)** 4:1
(d) 16 : 3 **(e)** 3 : 20
3 5 : 6 **4** 5 : 8 : 10 **5** 4 : 2 : 3

Exercise 5.2 (page 64)

1 **(a)** 1 : 3 **(b)** 1 : 5
(c) 1 : 2.5 **(d)** 1 : 1.75
(e) 1 : 7.5 **(f)** 1 : 125
(g) 1 : 0.2 **(h)** 1 : 500000
2 1 : 250000
3 1 : 6

Exercise 5.3 (page 68)

1 **(a)** 12 cm **(b)** 3.5 cm
2 **(a)** 24 babies **(b)** 9 helpers
3 **(a)** 6 litres **(b)** 4 litres
4 140 mm or 14 cm
5 **(a)** 28 miles **(b)** 10 inches
6 **(a)** 30 ml **(b)** 10 teaspoons
7 **(a)** 100 ml **(b)** 36 ml
8 **(a)** 150 g **(b)** 48 g
9 £120
10 **(a)** 500 g **(b)** 180 g

Exercise 5.4 (page 70)

1 Dave £8, Sam £12
2 **(a)** 15 litres **(b)** 25 litres
3 30 kg sand
4 **(a)** 50 ml **(b)** 250 ml
5 Amit £320, Bree £800, Chris £480
6 1560
7 £292
8 **(a)** 400 g **(b)** 80 g