

# Ratios

## Introduction

Ratios are an alternative way of expressing fractions. This leaflet revises ratio calculations.

## Ratio

Consider the problem of dividing £200 between two people, Ann and Bill, in the ratio 7 : 3. This means that Ann receives £7 for every £3 that Bill receives. So every £10 is divided as £7 to Ann and £3 to Bill. So Ann receives  $\frac{7}{10}$  of the money and Bill receives  $\frac{3}{10}$ . Now

$$\frac{7}{10} \times 200 = \text{£}140, \quad \frac{3}{10} \times 200 = \text{£}60$$

so Ann receives £140 and Bill receives £60.

Notice how when dividing the money in the ratio 7 : 3 we think of the total being made up of ten parts (7+3), with Ann being allocated seven of these parts, and Bill being allocated three.

The same is true more generally:

to divide a quantity in the ratio  $m : n$  we think of the total being made up of  $m + n$  parts, and split this as  $\frac{m}{m+n}$  and  $\frac{n}{m+n}$  of the total.

## Example

Divide 170 in the ratio 3:2.

## Solution

The total number of parts is  $3 + 2 = 5$ . We split the total as  $\frac{3}{5}$  and  $\frac{2}{5}$ . Thus

$$\frac{3}{5} \times 170 = 102, \quad \frac{2}{5} \times 170 = 68$$

## Example

Divide £18000 in the ratio 3:4:5.

## Solution

In this example we must split the total three ways. The total number of parts is  $3 + 4 + 5 = 12$  and the corresponding fractions are

$$\frac{3}{12}, \quad \frac{4}{12}, \quad \text{and} \quad \frac{5}{12}$$

$$\frac{3}{12} \times 18000 = 4500, \quad \frac{4}{12} \times 18000 = 6000, \quad \text{and} \quad \frac{5}{12} \times 18000 = 7500$$

## The simplest form of a ratio

A ratio remains unchanged if each of its constituent parts is multiplied or divided by the same number.

So, for example, the ratio

$$3 : 5 : 8 \quad \text{is the same as} \quad 6 : 10 : 16$$

Similarly

$$\frac{5}{4} : \frac{2}{3} \quad \text{is the same as} \quad 5 : \frac{8}{3} \quad (\text{by multiplying by } 4)$$

which is also the same as

$$15 : 8 \quad (\text{by multiplying the last result by } 3)$$

## Increasing quantities in a given ratio

Suppose we are asked to increase £60 in the ratio 8 : 5. What this means is that every £5 is increased to £8. Now there are  $\frac{60}{5} = 12$  lots of £5 in £60. If each is increased to £8 the total amount will then be  $12 \times 8 = £96$ .

This calculation is the same as

$$\frac{8}{5} \times 60 = 96$$

In general to increase a quantity  $Q$  in the ratio  $m : n$  we calculate

$$\frac{m}{n} \times Q$$

If  $m$  is less than  $n$  then the quantity will be decreased.

### Example

Decrease 1025 in the ratio 3 : 5.

### Solution

$$\frac{3}{5} \times 1025 = 615$$

### Exercises

1. Cartridge brass has a ratio of copper to zinc of 7:3. Calculate the mass of the metallic constituents in 50kg of cartridge brass.
2. Express the ratio  $\frac{1}{3} : 2$  in its simplest form.
3. Increase 450 in the ratio 3:2.

### Answers

1. 35kg copper, 15kg zinc.
2. 1:6
3. 675