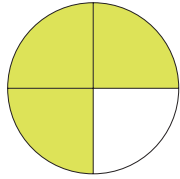


17 Ratio

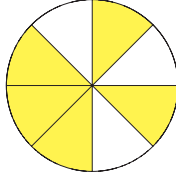
17.1 Introduction to ratio

- 1 a For each of these shapes, work out the proportion that is shaded.

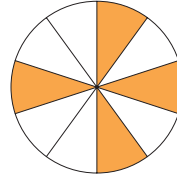
A



B



C



- b For each shape, complete these statements.
 i There are ... parts shaded out of ... parts altogether.
 ii ... in every ... parts are shaded.
 c What is the ratio of shaded to non-shaded parts?

- 2 a Sarah is one third of Danielle's age. What is the ratio of their ages?
 b The ratio of Sarah's age to Fiona's is 3 to 5. What fraction of Fiona's age is Sarah?

- 3 On a draughts board, there are two black pieces for every one white piece. There are 18 pieces on the board.

- a How many black pieces are there?
 b What proportion of the pieces is white?

- 4 Look at the squares below. One in every six squares is black.



Copy and complete the table.

Number of black squares	Number of white squares
1	5
2	10
3	
5	
8	
	50
	100

- 5 The number of pages in a Michael Morpurgo book is 75% of the number of pages in an Anthony Horowitz book. Work out the ratio of the number of pages in these two books.

- 6** a The film Spiderman 2 cost \$200 000 000 to make, but Spiderman 3 had a budget of \$300 000 000. Express this increase as a ratio in its simplest terms.
 b Pirates of the Caribbean cost \$225 000 000 to make. Express this as a ratio against Spiderman 3's budget.

- 7** A juice drink is supposed to be made by mixing one part juice to four parts water.
 a Write this as a ratio.
 The company produce a double concentrate version, which claims you can get the same flavour by mixing nine parts of water to one part juice.
 b Is the new bottle really double the strength of the original?
 c The original claims to offer 20 servings. According to their ratios, how many similar servings would you expect from the double version?

- 8** It is estimated that there are around 63 million pet dogs in the USA, 31 million in Brazil and 12 million in Japan.
 a Round these amounts to the nearest 10 million, and write them using figures not words.
 b How many times more pet dogs are there in the USA compared to Brazil?
 c How many times more pet dogs have the USA than Japan? Is it more sensible to round off the Japan figure first or leave it as it is?

17.2 Simplifying ratios

- 1** Simplify these fractions as much as possible

a $\frac{12}{15}$ b $\frac{10}{80}$ c $\frac{30}{18}$ d $\frac{135}{90}$

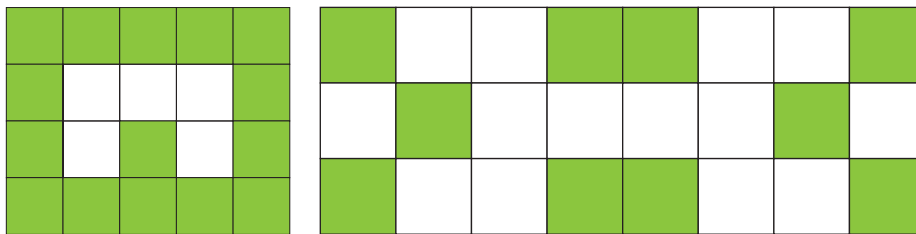
- 2** Reduce each of the following ratios to its simplest form.

a 9 : 6 b 8 : 20 c 24 : 30 d 200 : 900
 e 75 : 45 f 21 : 56

- 3** The Earth is reckoned to be about 70% water.

- a What fraction of the Earth is land?
 b Work out the ratio of water to land.

- 4** Write down the ratio of coloured to white squares for these grids.



- 5** The atmosphere of Uranus is made up of hydrogen and other gases in the ratio 6 : 1. A space probe filled two flasks with samples of the atmosphere.

- a One flask contained 18 litres of hydrogen. How many litres of other gases did it contain?
 b One flask contained $\frac{1}{2}$ litre of other gases. How much hydrogen did it contain?

- 6 Four football teams scored 250 goals altogether. Beetwood Rangers scored 50 goals, Trenton FC scored 100, Middleton Wanderers scored 25 and Pinkhams scored the rest.

- a Write down the percentage of the total goals that each team scored.
 b Write down each of the following goal ratios in its simplest form.
 i Beetwood Rangers : Trenton FC
 ii Middleton Wanderers : Pinkhams
 iii Pinkhams : Beetwood Rangers

- 7 The table shows the values for some common elements in the Universe.

Element	Relative atomic mass
Hydrogen	1
Helium	4
Carbon	12
Nitrogen	14
Oxygen	16
Silicon	28
Sulfur	32
Potassium	39
Copper	63

- a Work out the ratio of the masses of the following elements:
 i carbon to oxygen ii potassium to carbon iii silicon to copper.
 b Work out two elements where one mass is four times the other.
 c Find two elements in the ratio 3 : 1.

PS

- 8 The number of Number 1 singles by several artists in the UK is shown below:

Elvis Presley	21
Cliff Richard	14
Madonna	12
The Spice Girls	9

- a Simplify the following ratios:
 i Elvis to Cliff ii Madonna to Elvis iii male to female.
 b What fraction of the total did Cliff Richard achieve?
 c In numerical terms, how many more times successful was Elvis than the Spice Girls?

- 9 One weekend there were rugby league matches at Leeds, Wigan and Huddersfield. The attendances to the nearest thousand were 15 000 at Leeds and 12 000 at Wigan.

- a Write the ratio of the Leeds attendance to the Wigan attendance as simply as possible.
 b The ratio of the Wigan attendance to the Huddersfield attendance was 6 : 5. How many were in the crowd at Huddersfield to the nearest thousand?
 c What are the lowest and highest figures possible at Huddersfield?



A recipe for chocolate brownies is given as shown:

Plain chocolate	2 oz	50 g
Margarine	4 oz	100 g
Self-raising flour	4 oz	100 g
Brown sugar	6 oz	180 g
Eggs	2	2

- Ignoring the eggs, write the other amounts as ratios in their simplest form for both types of unit.
- A mistake has been made for one item when converting from imperial units to metric. What is the error, and what should the correct amount be?

Brain teaser

On a bicycle, the gear ratio is the ratio of the number of teeth on the chainring on the front to the number of teeth on the sprocket at the back.

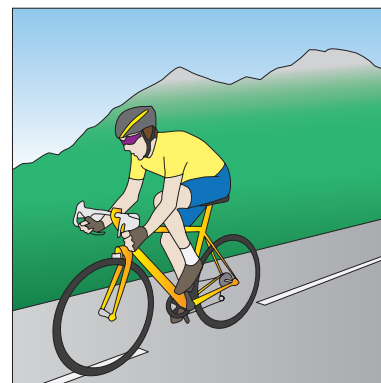
The higher the ratio from front to back, the more power you get downhill.

To make it easier going uphill you need the smallest possible ratio, preferably less than 1.

Mike's front chainring goes from 42 down to 24, and his rear sprocket set goes from 10 up to 28.

Bob's bike goes from 48 to 25 at the front and 12 to 30 at the back.

Use ratios and show your working to decide who has more power going downhill, and who has it slightly easier going uphill.



17.3 Ratios and sharing

- Divide £120 in each of these ratios.
 - 1 : 5
 - 4 : 1
 - 19 : 1
- Andrea divides up her free time in the ratio:
games console : reading = 4 : 1
She has 200 minutes of free time each day. How much time does she spend on each activity?
- 160 children go to a cinema one day. The ratio of those watching Planes to those watching The Lone Ranger is 3 : 5. How many children see each film?

- 4 Dominic has 20 coloured sweets left in a packet. These are in the ratio:
red : green = 1 : 4
- How many of each colour are there?
 - If he eats one red sweet and four green sweets, what is the new ratio red : green? Comment on your answer.
 - If he only ate one of each colour, what would the ratio change to?
- 5 A bakery normally makes white and brown bread in the ratio 5 : 2. One morning they count 350 white and 154 brown loaves, and realise they've baked too many brown loaves. How many brown loaves should they have baked?
- 6 Share 400 kg in each of these ratios.
- 1 : 2 : 5
 - 6 : 11 : 3
- 7 During the holidays, Andrew does the following activities:
playing cricket : reading : doing puzzle books = 9 : 6 : 4
He plays cricket for 6 hours. How many minutes does he spend on each activity?
- 8 Diane has 10 pairs of socks left in her drawer. These are in the ratio:
white : blue : black = 1 : 2 : 3
- How many of each colour are there? How many are there altogether?
 - If she wears one black pair and two blue pairs, what is the new ratio black : blue?
 - She then wears three pairs of white socks in a row. What is the new ratio for all three colours? Comment on your answer.

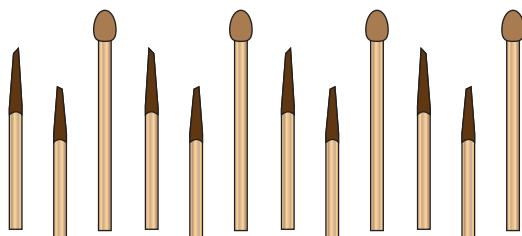
17.4 Solving problems

- 1 The table shows the seeds contained in four packets of Summer Border.

Flower	Number of seeds
Cloth of Gold	20
Delphinium	12
Penstemon	8
Mrs Perry	6

Calculate the number of each seed contained in the following:

- 12 packets
 - 6 packets.
- 2 In an orchestra, the ratio of cellists to violinists is 3 : 5. There are 20 violinists in the orchestra. How many cellists are there?
- 3 In the pattern below, one match in every three is unused. The proportion of unused matches is $\frac{1}{3}$.

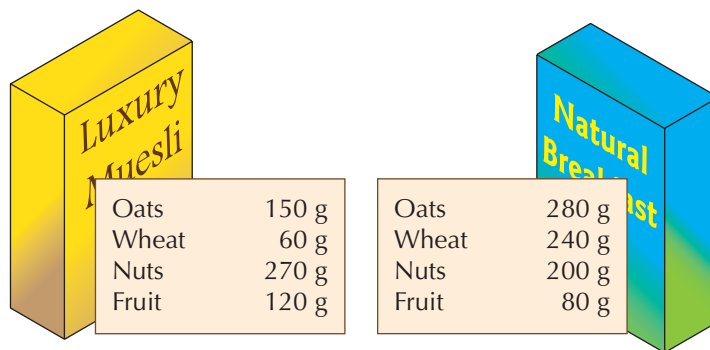


- a What is the proportion of used matches?
 b Copy and complete the table to show the sequence of used and unused matches.

Unused matches	Used matches	Total matches
1	2	3
2	4	
3		
6		
	20	

- c If you know the number of unused matches, how would you work out the number of used matches?
 d If you know the number of used matches, how would you work out the number of unused matches?
 e If you know the total number of matches, how would you work out the number of unused matches?
 f If you know the total number of matches, how would you work out the number of used matches?

4 The contents of two boxes of muesli are shown below.

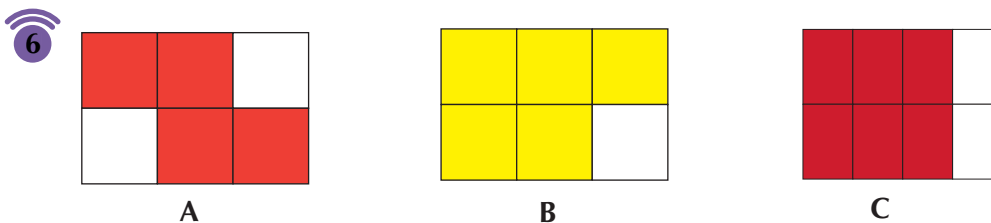


- a What is the total weight of each box?
 b Copy and complete the table below, which shows the proportion of each ingredient.

	Oats	Wheat	Nuts	Fruit
Luxury Muesli	25%			
Natural Breakfast				10%

5 Five kilograms of potatoes costs £2.80. Find the cost of the following:

- a 2.5 kg b 8 kg

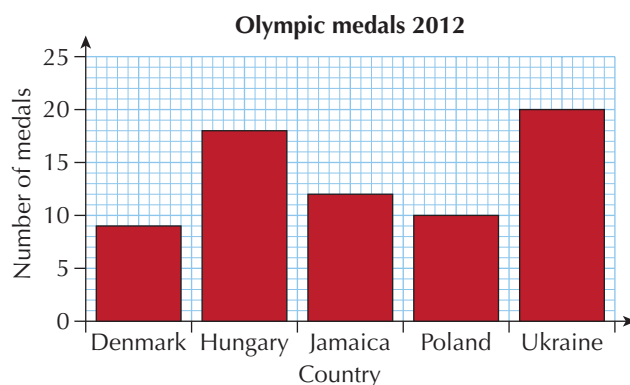


Look at the designs above.

- a What is the ratio of red to white in design A?
 b In designs A and B, why is the ratio of red to yellow **not** 5 : 4?
 c Why is the ratio of yellow to red in designs B and C **not** 5 : 6?

7

This bar chart shows the number of medals won by different countries in the 2012 Olympics.



- a Work out the ratio of medals won between the following countries:
 - i Denmark and Jamaica
 - ii Hungary and Poland.
- b Ukraine won twice as many medals as Poland. Which country won twice as many medals as Denmark?
- c Which two countries have the ratio of medals won of 3 : 5?
- d Which country only won 45% of the amount of medals won by Ukraine?

8

In a pack of cards, there are four suits: Spades and Clubs are black, Hearts and Diamonds are red. Each suit has 13 cards: the numbers from one to 10 plus three picture cards, Jack, Queen and King. The one (Ace) is usually counted as the highest in the suit.

- a How many cards are there in a pack?
- b What is the ratio of red cards to black cards?
- c
 - i Find the ratio of Spades to all other suits. What fraction of a whole pack are Spades?
 - ii Find the ratio of Aces to all other cards. What fraction of a pack are Aces?
 - iii Find the ratio of picture cards (Jack, Queen and King) to other cards. What fraction of a pack are picture cards?
 - iv What do you notice about the figures in corresponding fractions and ratios?

Brain teaser

In the card game Estimation, players have to predict how many tricks they think can win each round, getting points for each trick won, and 10 bonus points for a correct prediction.

Toby calls first. He gets the ten of Spades and has to decide what chance this card has of winning. He knows only the Jack, Queen, King and Ace of Spades can beat it, plus any one of thirteen trumps (Hearts). He decides to bid to win the round and plays his card. The other players are a little surprised. Rosa says she would have bid zero with that card, but Toby reckons his chance of winning is twice as high as his chance of losing. Use ratios to see if he was right or not.