

# fs4u

## Maths Level 1

### Section 3

## Working with ratio, proportion and formulae

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# fs4u

## Maths Level 1

**Section 1:** Working with Whole Numbers

**Section 2:** Working with Fractions,  
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and Formulae

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Space

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# E Working with ratio and proportion

You should already know how to:

- ✓ multiply and divide two-digit numbers by single-digit numbers.

By the end of this section you will know how to:

- interpret simple ratio as the number of parts
- find quantities in a given ratio
- use direct proportion to increase or decrease quantities.
- use simple scale to estimate distance on a road map.

## 1 Understanding ratios

### Learn the skill

In a class, there is 1 boy to every 2 girls. You can write this as a **ratio**:

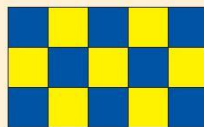
boy : girl = 1 : 2



A **ratio** is used to compare two or more quantities.

You write the quantities together with a colon (:) between them.

**Example 1:** What is the ratio of blue squares to yellow squares in this tiling pattern?



There are **7 yellow squares** and **8 blue squares**.

The question asks for the ratio of **blue to yellow**.

Answer: 8 : 7

Do not include units in ratios because they are comparing amounts of the same thing.

**Example 2:** A biscuit recipe takes 4 ounces of flour, 3 ounces of sugar and 1 ounce of butter. What is the ratio of butter to sugar to flour?

4 ounces flour, 3 ounces sugar, 1 ounce butter

Answer: 1 : 3 : 4

### Tip

Another way to say the ratio **8 : 7** is 'eight to seven'.

### Tip

Make sure you write the ratio in the order that is asked for in the question.

You can **simplify** ratios by dividing each part by the same number.

**Example 3:**

- a** simplify the ratio 8:6  
**b** write these amounts as ratios and simplify them **i** £6 to £2 **ii** £2 to 50p

**a** Divide 8 and 6 by 2.

Answer: 4 : 3

**b i** Omit the units. Divide both sides by 2.

Answer: 3 : 1

**ii** £2 is 200 pence. Omit the units. Divide both sides by 50.

Answer: 4 : 1

**Tip**

Always make sure that all parts are in the **same units** before you simplify a ratio.

1. There are nine females and eleven males waiting in a health clinic.

**a** What is the ratio of females to males? \_\_\_\_\_

**b** What is the ratio of males to females? \_\_\_\_\_

2. Gareth and Mena have £5 and £7, respectively. What is the ratio of Gareth's money to Mena's?

3. A biscuit recipe takes 150 g of flour, 100 g of sugar and 25 g of butter. What is the ratio of butter to sugar to flour?

4. Simplify these following ratios.

**a** 8 : 4      **b** 3 : 6      **c** 4 : 24      **d** 10 : 15

**e** 25 : 15      **f** 125 : 625      **g** £2 : £4      **h** £3 : 75p

**i** 2 : 4 : 8      **j** 4 : 10 : 12

5. There are five women and fifteen men working on a construction site. Write the ratio of women to men as a ratio in its simplest form.

6. Jackie and Bill set up a business together. They share the profits in the ratio of their initial investments.

Bill invests £2500 and Jackie invests £25 000. In what ratio do they share the profits?

7. A room has two windows. The larger window is 1.5 metres long and the smaller is 75 centimetres long. What is the ratio of the longer length to the shorter length?

8. Three friends decide to share a prize draw in the ratio of their ages. If their ages are 42, 63 and 49, in what ratio will they split the prize amount?

**Remember**

**Respectively** means 'in the order given'.

**Tip**

Make sure you divide all the parts by the same number.

**Remember**

Numbers that end in 0 or 5 can be divided by 5.

**Tip**

Convert 1.5 m into cm first. Remember that 1 m = 100 cm

**Challenge question!**

## 2 Using ratios to find quantities

### Learn the skill

For the ratio 2 : 1, there are three **parts** altogether. The first person has 2 parts. The second person has 1 part. You can find out how much **one part** is worth by dividing the total.

$$\begin{array}{c} 2 : 1 \\ \text{■} \quad \text{■} \\ 2 + 1 = 3 \end{array}$$

**Example 1:** A profit of £36 is to be divided between two business partners in the ratio 3 : 1.

- How much does the first partner get?
- How much does the second partner get?

Add the number of parts to find the total:  $3 + 1 = 4$   
Divide the total amount by the total number of parts to find the value of 1 part:  $£36 \div 4 = £9$

- The first partner gets three parts:  $3 \times £9$  Answer: £27
- The second partner gets one part:  $1 \times £9$  Answer: £9

**Example 2:** A father and son won some money and decided to share it in the ratio of 4 : 5, respectively. The father's part of the winnings was £120. How much did the son win?

The father's share was four parts: 4 parts =  
£120 1 part:  $£120 \div 4 = £30$   
The son had five parts:  $5 \times £30$

Answer: £150

### Tip

Start by finding how many parts there are altogether. Divide the total quantity by this number to find what one part is worth.

### Tip

Always look carefully at the question. You may need to include units in your answers.

### Try the skill

- £24 is to be split between two friends in the ratio 1 : 5. How much does each friend get?
- Water in a swimming pool is treated with two chemicals mixed in the ratio of 5 : 4. The total volume of the chemicals is 48 litres. How much of each chemical is used?
- Concrete consists of six parts gravel to one part cement. A builder makes up 140 kg of concrete mixture. What is the weight of gravel used in this mixture?
- A drink is made from juice and water in the ratio of 1:5. How many litres of drink can be made from 2 litres of juice?
- A student was given two tasks to do as part of an assignment.

The time taken to complete the first task compared with the second was in the ratio 1 : 8. If it took her 30 minutes to complete the first task, how long did it take to complete the second task?

### Tip

**Six parts to one part** means the ratio is 6 : 1.

### Challenge question!

# 3 Direct proportion

## Learn the skill

In a recipe, to make **double** the amount, you multiply all the quantities by 2.

**Example 1:** A recipe for four people takes 300 grams of flour. How many grams of flour would be needed if the same recipe is followed to feed:

- a** 8 people      **b** 2 people      **c** 20 people?

**a** 8 is double 4, so double the amount of flour:  $300 \times 2 = 600$

Answer: 600 grams


**b** 2 is half of 4, so halve the amount of flour:  $300 \div 2 = 150$

Answer: 150 grams

**c** 20 is five times 4, so multiply the amount of flour by 5:  
 $300 \times 5 = 1500$

Answer: 1500 grams

The quantities in the recipe stay in the same **proportion**.

 Two quantities are in **direct** proportion if the ratio stays the same as the quantities increase or decrease.

For example, when the number of people **doubles**, the amount of flour also **doubles**, so the number of people and the amount of flour stay in **direct** proportion.

## Try the skill

1. Lucy makes scones for a bakery. The bakery tends to sell twice as many fruit scones as cheese scones, and have asked Lucy to meet this demand.

If Lucy makes 48 cheese scones, how many fruit scones should she make?

2. This recipe is for three people.

**a** How many eggs will you need for six people?

**b** How much milk will you need for eighteen people?

3. Mixing 3 dessertspoons of custard powder with 450 ml of milk will make enough custard for two people.

How much milk should you mix with 1 dessertspoon of custard powder?

4. A car uses an average of 6 litres of fuel per 100 kilometres.

**a** How much fuel on average will the car use for 500 km?

**b** If the car uses 9 litres of fuel, what is the distance covered?

## Tip

To make half the amount, divide all the quantities by 2.

*Recipe:*  
Pancakes 3 eggs  
150 ml milk  
450 g flour

# 4 Using simple scales in scale diagrams

## Learn the skill



The scale on a drawing or map is a ratio.

On a map with a scale of 1 : 100, every length of 1 unit on the map represents a length of 100 units on the ground.

Real measurements (such as length or distance) can be worked out from **scales** on **maps** or **scale diagrams**.

**Example 1:** Study the scale diagram of a sports hall. Work out the length of the sports hall.

The sports hall measures 6 cm on the plan.

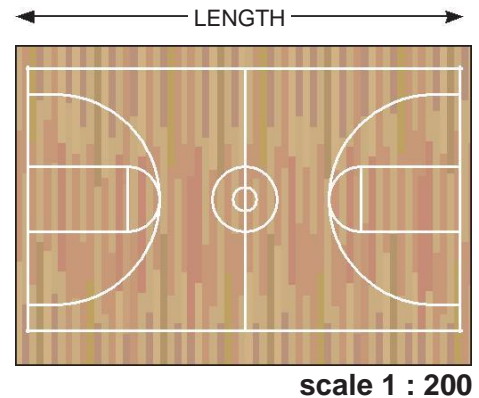
The scale is given as 1 : 200. This means that 1 cm on the plan represents 200 cm in real life.

To find the real length of the hall, multiply the length on the plan by 200:

$$6 \text{ cm on plan} \rightarrow 6 \times 200 \text{ cm} = 1200 \text{ cm}$$

$$1200 \div 100 = 12$$

Answer: 12 m



### Tip

1 m = 100 cm so to change centimetres into metres, divide by 100

## Try the skill

- Use the scale given to work out the real length for each of these map lengths.

*The first one is done for you.*

|   | Scale    | Diagram length | Real length (cm)  | Real length (m) |
|---|----------|----------------|-------------------|-----------------|
|   |          | 5 cm           | 5 X 50 cm =250 cm | 2.5 m           |
| a | 1 : 100  | 4 cm           |                   |                 |
| b | 1 : 200  | 8 cm           |                   |                 |
| c | 1 : 50   | 10 mm          |                   |                 |
| d | 1 : 5000 | 6 mm           |                   |                 |



- On a scale drawing, a garden path is 16 cm long. The scale is given as 1 : 25. What is the real length of the path in metres?



- On the plan of a nursery, the space for coats is 3 cm wide. The scale of the drawing is 1 : 50. How wide is the real coat space in metres?



- James and Abi are using a map to plan a walk. The distance on the map They plan to walk a distance of 8 cm on the map. If the scale of the map is 1 : 50 000, what is the real distance they plan to walk?

# 5 Remember what you have learned

## First complete this ...

- ▶ A \_\_\_\_\_ is used to compare two or more quantities.
- ▶ To write a \_\_\_\_\_ comparing two or more quantities, write the amounts together with a colon (:) between them, for example, 3 : 1 or 1 : 3 : 6.
- ▶ Two quantities are in \_\_\_\_\_ if one quantity increases or decreases in the same way as the other increases or decreases.

## Use the skill

1. A cordial drink is a mixture of three parts lemonade to one part cordial.

How much lemonade must be added to 3 pints of cordial?

- A  1 pint
- B  3 pints
- C  9 pints
- D  6 pints

2. A bricklayer mixes mortar using four shovels of sand to one shovel of cement. He makes a mix that has 12 shovels of sand.

How many shovels of cement are there in the mix?

- A  3
- B  4
- C  8
- D  5

3. This recipe is for two cheese pastries.

*Recipe: Cheese pastries 100 g flour  
25 g grated cheese  
25 ml milk  
25 g butter*

- A  100 g
- B  160 g
- C  200 g
- D  250 g

What amount of grated cheese will be needed to make 16 cheese pastries?



**Working with Ratio, Proportion, Formulae and Equations 3**

4. This recipe is for eight fruit scones.

*Recipe: Fruit scones*  
800 g self-raising flour  
100 g sugar  
200 g butter  
1 tablespoon milk  
200 g currants

How much flour will be needed to make two of these fruit scones?

- A  5 g
- B  50 g
- C  500 g
- D  800 g

5. The instructions on a bottle of weedkiller are given below.

## Kill weeds!

Instructions  
Dilute 1 part Weedkiller  
to 4 parts water.

A gardener has 250 ml of weedkiller.

How much water should he add to this?

- A  250 ml
- B  1000 ml
- C  1250 ml
- D  2500 ml

6. **Challenge question!**

A hairdresser mixes a total of 36 ml of colour.  
He uses twice as much copper colour as base colour.

Which colour mix is correct?

- A  9 ml copper and 27 ml base colour
- B  12 ml copper and 24 ml base colour
- C  24 ml copper and 12 ml base colour
- D  27 ml copper and 9 ml base colour

# F Working with formulae


By the end of this section you will know how to:

- find formulae expressed in words
- use formulae expressed in words

## 1 Formulae in words

### Learn the skill

A formula is a way of describing a rule or relationship.

 A formula can be expressed either in words with the word 'equals', or in symbols with an equals sign (=).

Formulae is the plural of formula.

Level One content focuses on finding and using formulae expressed in words.

**Example 1:** The cost of hiring a cement mixer is £30 per day.

Work out the cost of hiring the mixer for 7 days.

**The formula you need is:** Hire cost = number of days  $\times$  £30

So the cost =  $7 \times \text{£}30 = \text{£}210$

Answer: £210

**Example 2:** The cost of hiring a 26 inch plasma TV is an initial payment of £29 and a weekly hire cost of £10.

Work out the cost of hiring the TV for 26 weeks.

**The formula you need is:** Total hire cost = number of weeks  $\times$  £10 + £29

So the total cost =  $26 \times \text{£}10 + \text{£}29$

$$= \text{£}260 + \text{£}29$$

$$= \text{£}289$$

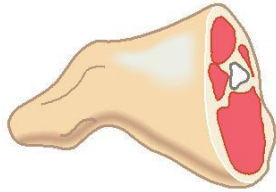
Answer: £289

### Tip

You need to multiply 26 by 10 first, and then add the 29

## Try the skill

1. The cost of hiring a carpet cleaner is £15 basic charge plus £18 per day. How much does it cost to hire the carpet cleaner for four days?
2. The amount a cleaner earns is £6.50 per hour worked. Use this rule to work out what she earns in 7 hours.
3. To cook a joint of lamb takes 40 minutes per kilogram plus an additional 20 minutes.



Use this rule to work out the time needed to cook a joint of lamb weighing 6 kg.

4. The cost of hiring a car is £20 per day plus £0.25 for every mile driven.

What is the cost of hiring a car for six days?

### 5. Challenge question!

A mobile phone company charges £12 per month for its mobile phones, plus 6 pence per minute for phone calls made. What is the charge in a month where a woman makes 500 minutes of phone calls?



6. The area of the walls in Simon's room is 40 square metres altogether. A tin of matt paint covers 8 square metres. A tin of silk paint covers 6 square metres.

To work out the number of tins of paint he needs Simon used this rule:

Number of tins of paint = total area of walls  $\div$  number of square metres the paint covers

- a How many tins of **matt** paint would he need to buy, to paint the walls once?
- b How many tins of **silk** paint would he need to buy, to paint the walls once?

### Tip

If you are struggling to find a formula, try working out the problem with actual values first. Did you multiply, add, subtract or divide?

### Tip

Change the quantities to either pounds or pence before you start calculating

### Remember

Area of a rectangle = length  $\times$  width

## 2 Remember what you have learned

### Use the skill

1. What formula can be used to work out the gross wage for an employee if they are paid a fixed amount per hour?  
**A** number of hours worked  $\div$  amount paid per hour  
**B** amount paid per hour  $\div$  number of hours worked  
**C** amount paid per hour  $+$  number of hours worked  
**D** amount paid per hour  $\times$  number of hours worked

2. A company charges £40 and an additional £25 per day to hire a sander.

Which formula will correctly calculate the cost of hiring the sander for a number of days?

- A**  $\text{£}40 \times \text{number of hire days} + \text{£}25$   
**B**  $(\text{£}40 + \text{£}25) \times \text{number of hire days}$   
**C**  $\text{£}40 + \text{number of hire days} \times \text{£}25$   
**D**  $\text{£}40 \times \text{number of hire days} + \text{number of hire days} \times \text{£}25$



3. A cleaning company charges a fixed fee of £50 plus £7.50 per hour for cleaning.

How much does the company charge for 5 hours of cleaning?

- A**  £62.50  
**B**  £85  
**C**  £87.50  
**D**  £207.50

4. A printing company charge £0.08 to print each leaflet and an additional fixed charge of £25.

How much would the company charge to print 500 leaflets?

- A**  £29  
**B**  £65  
**C**  £87.50  
**D**  £425

5. A recipe book says that the cooking time for a chicken is given by:

Time in minutes =  $40 \times \text{weight in kilograms} + 20$

How long would it take to cook a chicken weighing 5 kg?

- A** 140 minutes                      **C** 220 minutes  
**B** 200 minutes                      **D** 300 minutes

- A**  140 minutes  
**B**  200 minutes  
**C**  220 minutes  
**D**  300 minutes