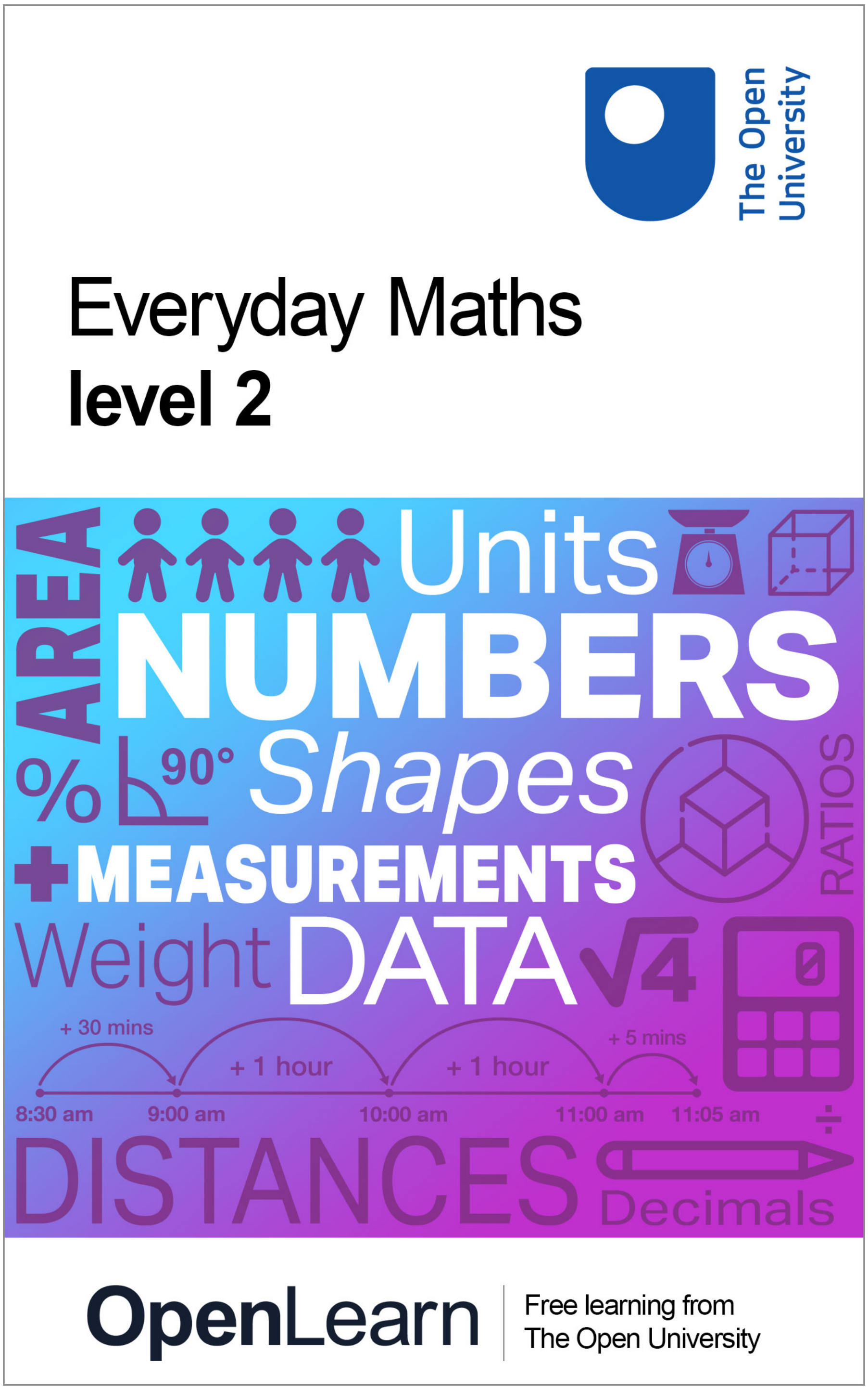
Everyday Maths 2


The Open University
Everyday Maths
level 2
AREA
Units
NUMBERS
%
90°
Shapes
MEASUREMENTS
RATIOS
Weight
DATA
√4
0
+ 30 mins
+ 1 hour
+ 1 hour
+ 5 mins
8:30 am
9:00 am
10:00 am
11:00 am
11:05 am
DISTANCES
Decimals
OpenLearn
Free learning from
The Open University

Contents

Introduction and guidance

Introduction and guidance

This free badged course, *Everyday maths 2*, is an introduction to Level 2 Functional Skills in maths. It is designed to inspire you to build on your existing maths skills by working through examples and interactive activities. These have been designed around everyday situations like calculating how long it will take to get from one place to another or how to convert currencies when you go on holiday. The course may also enhance your career prospects or help if you are considering an apprenticeship.

On completing the course you should feel confident to tackle the maths you come across in everyday situations. You may also be able to help support children with their challenging maths homework and help them become more confident too.

You can work through the course at your own pace. To complete the course you will need access to a calculator, notepad, pen and protractor.

The course has four sessions, with a total study time of approximately 48 hours. The sessions cover the following topics: numbers, measurement, data, and shapes and space. There will be plenty of examples to help you as you progress, together with opportunities to practise your understanding.

The regular interactive quizzes form part of this practice, and the end-of-course quiz is an opportunity to earn a badge that demonstrates your new skills. You can read more on how to study the course and about badges in the next sections.

After completing this course you should be able to:

- understand practical problems in familiar and unfamiliar contexts and situations
- identify the problems to be solved and identify the mathematical methods needed to solve them
- select mathematical methods in an organised way to find solutions
- apply a range of mathematics in an organised way to find solutions to straightforward practical problems
- use appropriate checking procedures at each stage
- interpret and communicate solutions to multi-stage practical problems drawing simple conclusions and giving appropriate justifications.

Moving around the course

The easiest way to navigate around the course is through the ‘My course progress’ page. You can get back there at any time by clicking on ‘Back to course’ in the menu bar.

It’s also good practice, if you access a link from within a course page (including links to the quizzes), to open it in a new window or tab. That way you can easily return to where you’ve come from without having to use the back button on your browser.

What is a badged course?

While studying *Everyday maths 2* you have the option to work towards gaining a digital badge.

Badged courses are a key part of The Open University's mission *to promote the educational well-being of the community*. The courses also provide another way of helping you to progress from informal to formal learning.

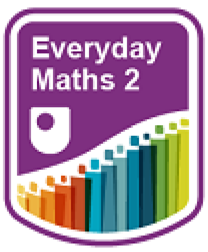
To complete a course you need to be able to find about 48 hours of study time. It is possible to study them at any time, and at a pace to suit you.

Badged courses are all available on The Open University's OpenLearn website and do not cost anything to study. They differ from Open University courses because you do not receive support from a tutor. But you do get useful feedback from the interactive quizzes.

What is a badge?

Digital badges are a new way of demonstrating online that you have gained a skill. Schools, colleges and universities are working with employers and other organisations to develop open badges that help learners gain recognition for their skills, and support employers to identify the right candidate for a job.

Badges demonstrate your work and achievement on the course. You can share your achievement with friends, family and employers, and on social media. Badges are a great motivation, helping you to reach the end of the course. Gaining a badge often boosts confidence in the skills and abilities that underpin successful study. So, completing this course should encourage you to think about taking other courses, for example enrolling at a college for a formal qualification. (You will be given details on this at the end of the course.)



How to get a badge

Getting a badge is straightforward! Here's what you have to do:

- read all of the pages of the course
- score 70% or more in the end-of-course quiz.

For all the quizzes, you can have three attempts at most of the questions (for true or false type questions you usually only get one attempt). If you get the answer right first time you will get more marks than for a correct answer the second or third time. Therefore, please be aware that for the end-of-course quiz (Session 4 compulsory badge quiz) it is possible to get all the questions right but not score 70% and be eligible for the OpenLearn badge on that attempt. If one of your answers is incorrect you will often receive helpful feedback and suggestions about how to work out the correct answer.

If you're not successful in getting 70% in the end-of-course quiz the first time, after 24 hours you can attempt it again and come back as many times as you like.

We hope that as many people as possible will gain an Open University badge – so you should see getting a badge as an opportunity to reflect on what you have learned rather than as a test.

If you need more guidance on getting a badge and what you can do with it, take a look at the OpenLearn FAQs. When you gain your badge you will receive an email to notify you and you will be able to view and manage all your badges in My OpenLearn within 24 hours of completing the criteria to gain a badge.

Now get started with Session 1.

Session 1: Working with numbers

Introduction

With an understanding of numbers you have the basic skills you need to deal with much of everyday life. In this session, you will learn about how to use each of the four different mathematical operations and how they apply to real life situations. Then you will encounter fractions and percentages which are incredibly useful when trying to work out the price of an item on special offer. Additionally, you will learn how to use ratio – handy if you are doing any baking – and how to work with formulas.

Throughout the course there will be various activities for you to complete in order to check your skills. All activities come with answers and show suggested working. It is important to know that there are often many ways of working out the same calculation. If your working is different to that shown but you arrive at the same answer, that's perfectly fine.

By the end of this session you will be able to:

- use the four operations to solve problems in context
- understand rounding and look at different ways of doing this
- solve equations involving negative numbers
- use fractions, decimals and percentages and convert between them
- solve different types of ratio problems
- use inverse operations to check your calculations.

Video content is not available in this format.

1 Four operations

You will already be using the four operations in your daily life (whether you realise it or not). Everyday life requires you to carry out maths all the time; checking you've been given the correct change, working out how many packs of cakes you need for the children's birthday party and splitting the bill in a restaurant are all examples that come to mind.

Figure 1 Fruit maths puzzle

The four operations are addition, subtraction, multiplication and division. As Functional Skills exam papers allow the use of a calculator throughout, you do not need to be able to work out these calculations by hand but you do need to understand what each operation does and when to use it. At level 2, you will often be required to use more than one operation to answer a question.

- **Addition (+)**
    - This operation is used when you want to find the total, or sum, of two or more amounts.
- **Subtraction (−)**
    - This operation is used when you want to find the difference between two amounts or how much of something you have left after a quantity is used – for example, if you want to find the change owed after spending an amount of money.
- **Multiplication (×)**
    -

This operation is also used for totals and sums but when there is more than one of the same number – for example if you are buying five packs of apples that cost £1.20 each, you would do 5 × £1.20.

- **Division (÷)**
  - Division is used when sharing or grouping items. For example, if you want to know how many doughnuts you can buy with £6 if one doughnut costs £1.50, you would do £6 ÷ £1.50.

Activity 1: Operation choice

Each of the four questions below uses one of the four operations. Match the operation to the question.

Match each of the items above to an item below.

You need to save £306 for a holiday. You have 18 months to save up that much money. How much do you need to save per month?

Fourteen members of the same family go on holiday together. They each pay £155. What is the total cost of the holiday?

You make an insurance claim worth £18,950. The insurance company pays you £12,648. What is the difference between what you claimed and what you actually received?

You go to the local café and buy a coffee for £2.35, a tea for £1.40 and a croissant for £1.85. How much do you spend?

1.1 Combining operations

Often in daily life you will come across problems that require you to use more than just one of the operations in order to answer the question.

Example: Combining operations

Four friends are planning a holiday. The table below shows the costs:

Table 1

Item	Price
Flight (return)	£305 per person
Taxes	£60 per person
Hotel	£500 per room. 2 people per room
Taxi to airport	£45

The friends will be sharing the total cost equally between them. How much do they each pay?

Method

First we use multiplication to find the cost of items that we need more than one of:

> Flights = £305 × 4 = £1220
> Taxes = £60 × 4 = £240
> Hotel = 2 rooms required for 4 people = £500 × 2 = £1000

Now we use addition to add these totals together along with the taxi fare:

> £1220 + £240 + £1000 + £45 = £2505

Finally, we need to use division to find out how much each person pays:

> £2505 ÷ 4 =£626.25 each

Activity 2: Combining operations

Your current mobile phone contract costs you £24.50 per month.

You are considering changing to a new provider. This provider charges £19.80 per month along with an additional, one off connection fee of £30.

How much will you save over the year by switching to the new provider?

Answer

£24.50 × 12 = £294 (current provider)

£19.80 × 12 = £237.60

£237.60 + £30 = £267.60 (new provider)

£294 − £267.60 = £26.40 saved

The answer to Activity 2 is a convenient, exact amount of money. However, often when you perform calculations, especially those involving division, you do not get an answer that is suitable for the question. This leads you to the next section: rounding.

Summary

In this section you have:

- revised the four operations – addition, subtraction, multiplication and division
- practised using these operations including combining them to solve problems.

2 Rounding

Why might you want to round numbers? You may wish to estimate the answer to a calculation or to use a guide rather than work out the exact total. Alternatively, you might wish to round an answer to an exact calculation so that it fits a given purpose, for example an answer involving money cannot have more than 2 digits after the decimal point. You will now explore each of these examples in more detail and practise your rounding skills in context.

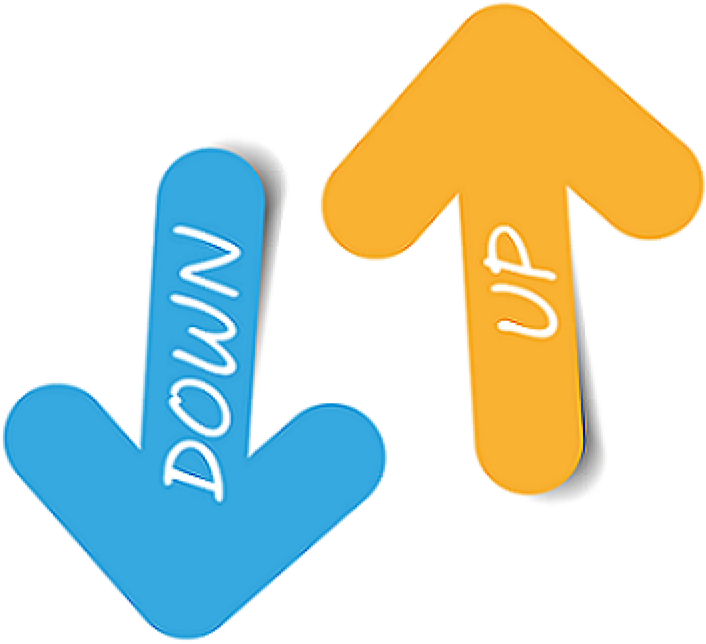


Figure 2 Rounding up and down

2.1 Rounding up or down after division

After carrying out a calculation you may not have an answer that is suitable.

For example, you are packing items and need to pack 100 items into boxes of 12. After performing the calculation 100 ÷ 12 you arrive at an answer of 8.3333.

This is not particularly helpful as you cannot have 8.3333 boxes. Therefore, you need to round this answer up to 9 boxes. You cannot round down to 8 boxes since some of the items would not get packed.

In other situations, you may need to round an answer down. If you were cutting a length of wood that is 2 m (200 cm) long into smaller pieces of 35 cm you would initially do the calculation 200 ÷ 35. This would give an answer of 5.714…. As you will only actually be able to get 5 pieces of wood that are 35 cm long, you need to round your answer of 5.714 down to simply 5.

Note: The three full stops used in the answer above (5.714…) is a character called an ellipsis. In maths it is used to represent recurring decimal numbers so you don't have to display them all.

Activity 3: Dividing and rounding

Decide whether the following calculations need to be rounded up or down after calculation of the division sum.

1. Apples are being packed into boxes of 52. There are 1500 apples that need packing. How many boxes are required?
2. A bag of flour contains 1000 g. Each batch of cakes requires 150 g of flour. How many batches can you make?
3. A child gets £2.50 pocket money each week. They want to buy a computer game that costs £39.99. How many weeks will they need to save up in order to buy the game?
4. A length of copper pipe measures 180 cm. How many smaller pieces that each measure 40 cm can be cut from the pipe?

Answer

1. 1500 ÷ 52 = 28.84 which must be rounded up to 29 boxes.
2. 1000 ÷ 150 = 6.666 which must be rounded down to 6 batches.
3. £39.99 ÷ £2.50 = 15.996 which must be rounded up to 16 weeks.
4. 180 ÷ 40 = 4.5 which must be rounded down to 4 pieces.

2.2 Rounding to approximate an answer

You might round in order to approximate an answer. At the coffee shop, you might want to buy a latte for £2.85, a cappuccino for £1.99 and a tea for £0.99. It is natural to round these amounts up to £3, £2 and £1 in order to arrive at an approximate cost of £6 for all three drinks.

Activity 4: Approximation

Find an approximate answer to each of the following.

1. Cost of 3 kg of bananas at 79p per kg.
2. The total cost of 3 books at £1.99, £2.85 and £4.90.
3. Change from a £20 note when £3.84 has been spent.
4. Approximate cost of one carton of fruit juice when a pack of 4 are sold together for 99p.

Answer

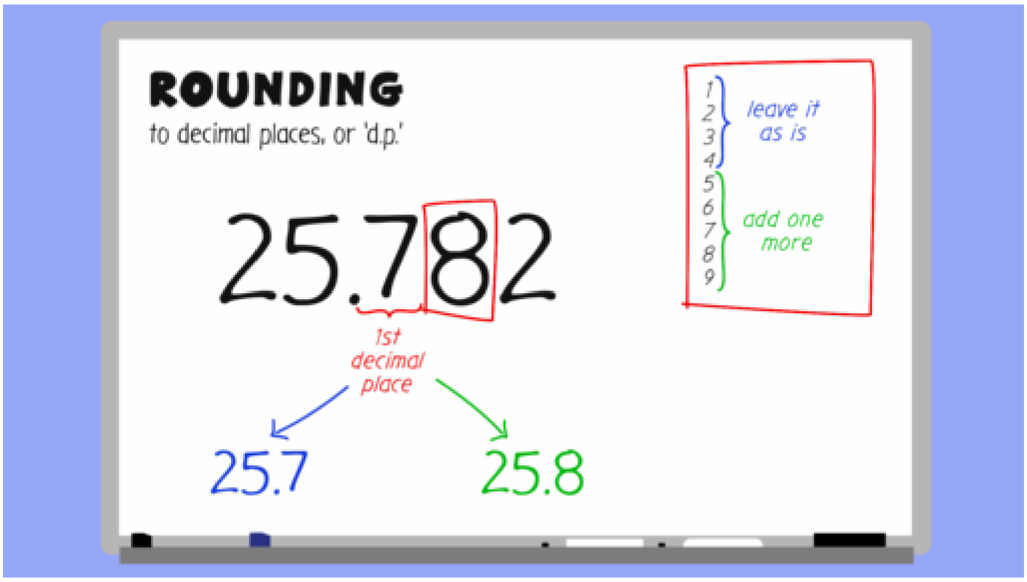
1. Approximate cost: 3 × 80p = 240p = £2.40
2. Approximate cost: £2 + £3 + £5 = £10

3. Approximate change: £20 − £4 = £16
4. Approximate cost of one carton: 100p ÷ 4 = 25p

2.3 Rounding to a degree of accuracy

Watch the short video below to see an example of how to round to one, two and three decimal places.

Video content is not available in this format.



Remember this rounding rhyme to help you:

Figure 3 A rounding rhyme

Activity 5: Rounding skills

Practise your rounding skills by completing the below.

1. What is 24.638 rounded to one decimal place?
2. What is 13.4752 rounded to two decimal places?
3. What is 203.5832 rounded to two decimal places?
4. What is 345.6795 rounded to three decimal places?

Answer

1. 24.6
2. 13.48
3. 203.58
4. 345.680

Summary

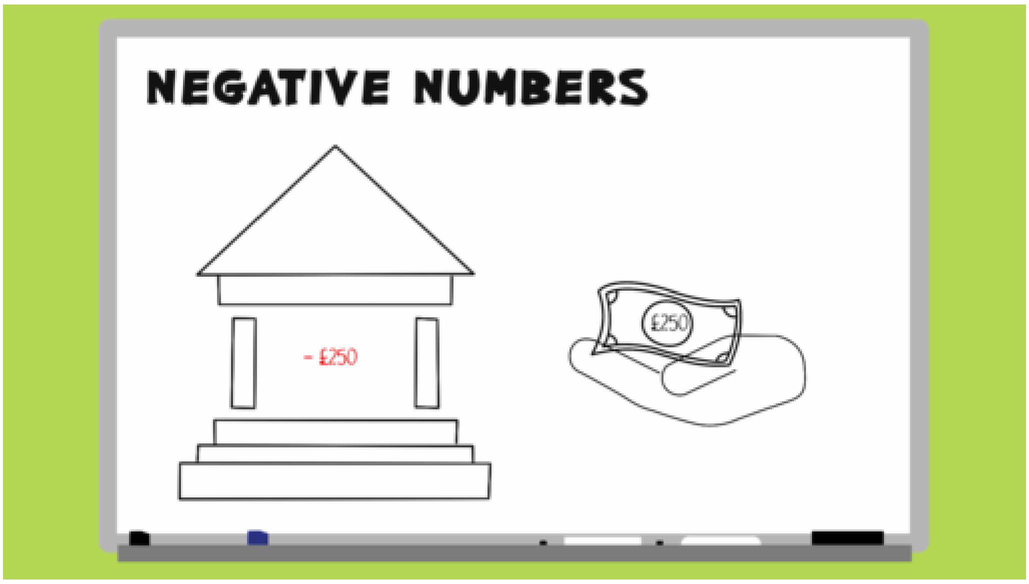
In this section you have learned:

- how to decide whether an answer to a division calculation needs to be to rounded up or down, depending on the context of the question
- how and when to use rounding to approximate an answer to a calculation
- how to round an answer to a given degree of accuracy – e.g. rounding to two decimal places.

3 Negative numbers

Negative numbers come into play in two main areas of life: money and temperature. Watch the animations below for some examples.

Video content is not available in this format.



Activity 6: Negative and positive temperature

1. The table below shows the temperatures of cities around the world on a given day.

Table 2

London	Oslo	New York	Kraków	Delhi
4˚C	−12C	7˚C	−3˚C	19˚C

a. Which city was the warmest?

b. Which city was the coldest?

c. What is the difference in temperature between the warmest and coldest cities?

Answer

1.

a.

Delhi was the warmest city as it has the highest positive temperature.

b.

Oslo was the coldest city as it has the largest negative temperature.

c.

The difference between the temperatures in these cities is 31˚C. From 19˚C down to 0˚C is 19˚C and then you need to go down a further 12˚C to get to −12˚C.

---

2. Look at this bank statement.

Figure 4 A bank statement

b.

On which days was Sonia Cedar overdrawn, and by how much?

c.

How much money was withdrawn on 11 October?

d.

How much was added to the account on 15 October?

Answer

2.

b.

The minus sign (−) indicates that the customer is overdrawn, i.e. owes money to the bank.The amount shows how much they owe. So Sonia Cedar was overdrawn on 11 October by £20 and by £50 on 21 October.

c.

£120 was withdrawn on 11 October. The customer had £100 in the account and must have withdrawn another £20 (i.e. £100 + £20 = £120 in total) in order to have a £20 overdraft.

d.

The customer owed £20 and is now £70 in credit, so £90 must have been added to the account.

You have now learned how to use all four operations and how to work with negative numbers. Every other mathematical concept hinges around what you have learnt so far; so once you are confident with these, you can do anything! Fractions, for example, are linked very closely to division and multiplication. Let’s put your newly found skills to good use in the next section, which deals with fractions.

Summary

In this section you have:

- learned the two main contexts in which negative numbers arise in everyday life – money (or debt!) and temperature

- practised working with negative numbers in these contexts.

4 Fractions

You will be used to seeing fractions in your everyday life, particularly when you are out shopping or scouring the internet for the best deals. It's really useful to be able to work out how much you'll pay if an item is on sale or if a supermarket deal really is a good deal!

Figure 5 A poster advertising a sale

There are several different elements to working with fractions. First you will look at how to express a quantity as a fraction of another quantity.

4.1 Writing a quantity of an amount as a fraction

Writing a quantity of an amount as a fraction might sound complicated, but it's actually very logical. Look at the example below.

Figure 6 Smarties in different colours

In Figure 6, what fraction of Smarties are red?

=

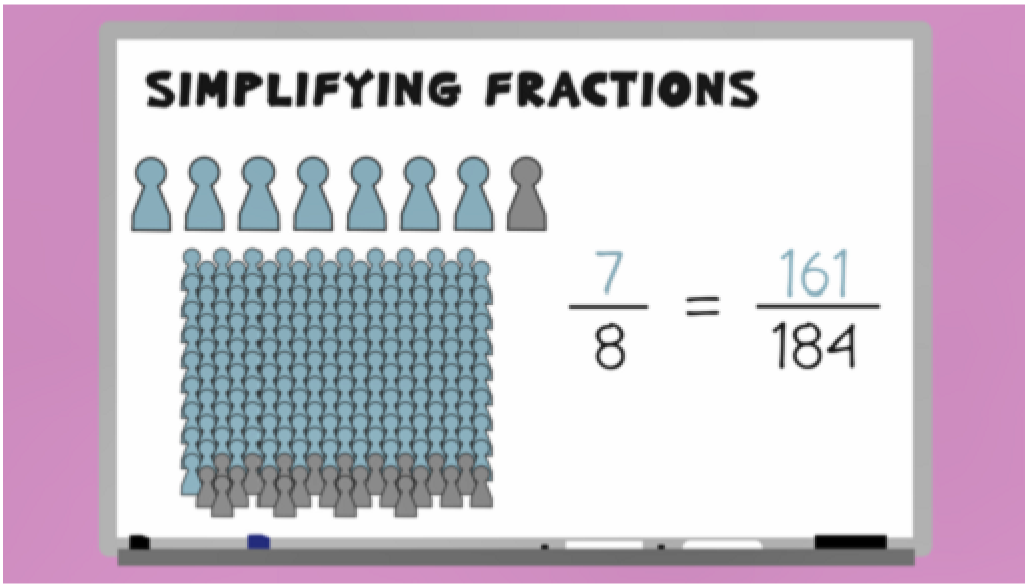
To express the fraction of Smarties that are red, you simply need to count the red Smarties (4) and the total number of Smarties (30) Since there are 4 red Smarties out of 30 altogether, the fraction is . It is worth noting here that this could also be written as 4/30.

You may well be asked to give an answer as a fraction in it's simplest form, which leads you nicely to the next section.

4.2 Simplifying fractions

Watch the video below which looks at how to simplify fractions before having a go yourself in Activity 7.

Video content is not available in this format.



Activity 7: Simplest form fractions

1. A local supermarket conducted a survey of 100 customers. 86 of them said they felt they got good value for money. Express this as a fraction in its simplest form.
2. 30 people entered a raffle. 6 of these people won a prize. What fraction of people did not win a prize? Give your answer as a fraction in its simplest form.

Answer

1. The initial fraction here is 86/100. This simplifies to 43/50 (divide top and bottom by 2)
2. As this question wants the number of people who did not win a prize we must first do 30 − 6 = 24 people did not win a prize.

   As a fraction this becomes 24/30 which simplifies to 12/15 (divide top and bottom by 2).

   This can be further simplified to 4/5 (divide top and bottom by 3).

Now that you can express a quantity as a fraction and simplify fractions, the next step is to be able to work out fractions of amounts. For example, if you see a jacket that was priced at £80 originally but is in the sale with 2/5 off, it’s useful to be able to work out how much you will be paying.

4.3 Fractions of amounts

Fractions of amounts can be found by using your division and multiplication skills. To work out a fraction of any amount you first divide your amount by the number on the bottom of the fraction – the denominator. This gives you 1 part.

You then multiply that answer by the number on the top of the fraction – the numerator.

It is worth noting here that if the number on the top of the fraction is 1, multiplying the answer will not change it so there is no need for this step. Take a look at the examples below.

Example: Divide by the denominator

Method

To find of 90 we do 90 ÷ 5 = 18.

Since the number on the top of our fraction is 1, we do not need to multiply 18 by 1 as it will not change the answer.

So of 90 = 18.

Example: Multiply by the numerator

Method

To find of 42 we do 42 ÷ 7 = 6.

This means that of 42 = 6.

Since you want of 42, we then do 6 × 4 = 24.

So of 42 = 24.

Let's go back to the jacket that used to cost £80 but is now in the sale with 2/5 off. How do you find out how much it costs? Firstly, you need to find 2/5 of 80. To calculate this you do:

£80 ÷ 5 = £16 and then £16 × 2 = £32

This means that you save £32 on the price of the jacket. To find out how much you pay you then need to do £80 − £32 = £48.

Activity 8: Comparing fractions of amounts

You are looking to buy house insurance and want to get the best deal. Put the following offers in order, from cheapest to most expensive, after the discount has been applied.

Table 3

Company A	Company B	Company C
£120 per year	£147 per year	£104 per year
Special Offer: 1/3 off!	Special Offer: 2/7 off!	Special Offer: 1/4 off!

Answer

Company C is cheapest:

1/4 of £104 = £104 ÷ 4 = £26 discount

£104 − £26 = £78

Company A is second cheapest:

1/3 of £120 = £120 ÷ 3 = £40 discount

£120 − £40 = £80

Company B is most expensive:

2/7 of £147 = £147 ÷ 7 × 2 = £42 discount

£147 − £42 = £105

Discounts and special offers are not always advertised using fractions. Sometimes, you will see adverts with 10% off or 15% off. Another common area where we see percentages in everyday life would be when companies apply VAT at 20% to items or when a restaurant adds a 12.5% service charge. The next section looks at what percentages are, and how to calculate them.

Summary

In this section you have:

- learned how to express a quantity of an amount in the form of a fraction
- learned how to, and practised, simplifying fractions
- revised your knowledge on finding basic fractions of amounts and progressed to finding more complex fractions of amounts.

5 Percentages

The good news about percentages is if you can work out a fraction of an amount, you can work out a percentage of amount.

Figure 7 Percentage discounts in a sale

Percentages are just fractions where the number on the bottom of the fraction must be 100. If you wanted to find out 15% of 80 for example, you work out of 80, which you already know how to do!

5.1 Calculating a percentage of an amount

Working out the percentage of an amount requires a similar method to finding the fraction of an amount. Take a look at the examples below to increase your confidence.

Example: Finding 17% of 80

Method

17% of 80 = of 80, so we do:

$$80 \div 100 \times 17 = 13.6$$

Example: Finding 24% of 60

Method

24% of 60 = of 60, so we do:

$$60 \div 100 \times 24 = 14.4$$

Just as with fractions, you will often need to be able to work out the price of an item after it has been increased or decreased by a given percentage. The process for this is the same as with fractions; you simply work out the percentage of the amount and then add it to, or subtract it from, the original amount.

Activity 9: Percentages of amounts

1. You earn £500 per month. You get a 5% pay rise.
   a.
      How much does your pay increase by?
   b.

How much do you now earn per month?

Answer

1.

a.

5% of £500 = of £500 = 500 ÷ 100 × 5 = £25.

b.

£500 + £25 = £525 per month.

---

2. You buy a new car for £9,500. By the end of the year its value has decreased by 20%.

b.

How much has the value of the car decreased by?

c.

How much is the car worth now?

Answer

2.

b.

20% of £9500 = of £9500 = £9500 ÷ 100 × 20 = £1900. The car has decreased by £1900.

c.

The car is now worth: £9500 − £1900 = £7600.

---

3. You invest £800 in a building society account which offers fixed-rate interest at 4% per year.

c.

How much interest do you earn in one year?

d.

How much do you have in your account at the end of the year?

Answer

3.

c.

4% of £800 = of £800 = £800 ÷ 100 × 4 = £32 interest earned.

d.

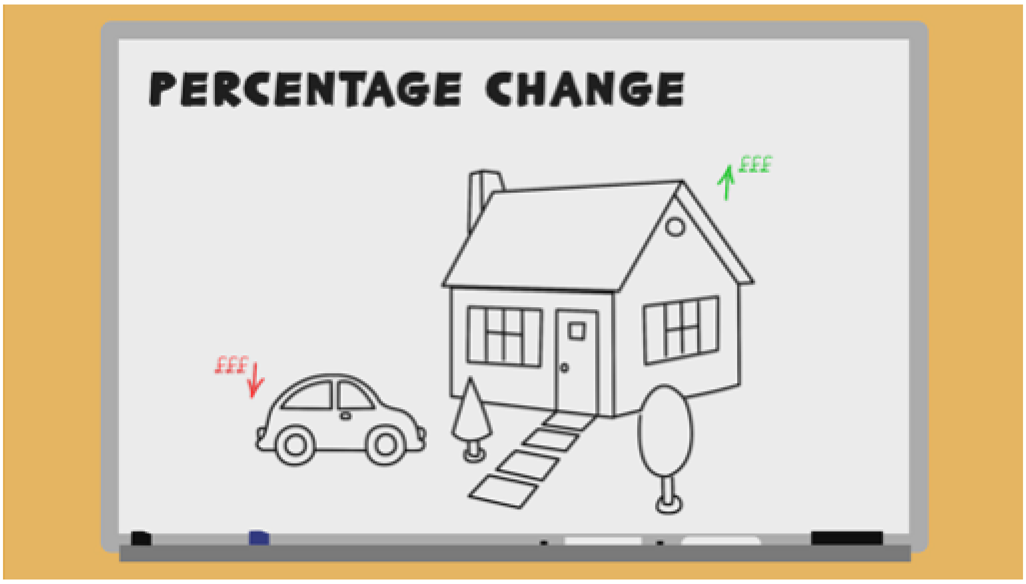
£800 + £32 = £832 in the account at the end of the year.

There are two other skills that relate to percentages that are very useful to know. The first is percentage change. This can be useful for working out the percentage profit (or loss) or finding out by what percentage an item has increased or decreased in value.

5.2 Percentage change

Watch the video below on how to calculate percentage change, then complete Activity 10.

Video content is not available in this format.



Activity 10: Percentage change formula

Practise using the percentage change formula which you learned about in the video above on the three questions below. Where rounding is required, give your answer to two decimal places.

1. Last year, your season ticket for the train cost £1300. This year the cost has risen to £1450. What is the percentage increase?

Answer

1. Difference: £1450 − £1300 = £150
   a. Original: £1300
   b. Percentage change = £150 ÷ £1300 × 100 = 11.54% increase (rounded to two d.p.)

---

2. You bought your house 10 years ago for £155,000. You are able to sell your house for £180,000. What is the percentage increase the house has made?

Answer

2. Difference: £180,000 − £155,000 = £25,000
   b. Original: £155,000

c.

Percentage change = £25,000 ÷ £155,000 × 100 = 16.13% increase (rounded to two d.p.)

3. You purchased your car 3 years ago for £4200. You sell it to a buyer for £3600. What is the percentage decrease of the car?

Answer

1. Difference: £4200 − £3600 = £600

a.

Original: £4200

b.

Percentage change = £600 ÷ £4200 × 100 = 14.29% decrease (rounded to two d.p.)

5.3 Reverse percentages

Say you are out shopping and see a pair of shoes advertised with a sale price of £35 and the shop is advertising 20% off everything. Whilst it is clear that £35 is the sale price after the 20% discount has been applied, how much did the shoes cost originally? In this case, you cannot simply work out 20% of the £35 and add it on – you need to use reverse percentages.

Example: 80% = £35

We know that 80% = £35. Since we want to know what 100% is, we can start by finding what 1% is worth. We can do this by dividing both sides by 80.

Once we know what 1% is worth, we can find 100% (original price) by multiplying both sides by 100.

Method

80% = £35
[÷ *both sides of the equation by 80*]
1% = 0.4375
[× *both sides of the equation by 100*]
100% = £43.75 (to two d.p.)

The original price of the shoes was therefore £43.75. Whilst these calculations often require some rounding to be done with the answer, it is important that you do not round until the final stage. If you round too early, you risk altering the answer.

Take a look at one more example before trying one yourself. Let's say that you find a kettle that costs £24.50. You can see from the ticket that it already has 15% taken off the original price.

Example: 85% = £24.50

This time then, we know 85% of the original cost is worth £24.50 (this is calculated by doing 100% − 15%).

Method

85% = £24.50

[÷ *both sides of the equation by 85*]

1% = 0.28823…

[× *both sides of the equation by 100*]

<u>100% = £28.82</u>

This approach can also be used if an item has increased by a given percentage. If, for example, you had a 5% pay rise and now earn £400 a week, you could calculate in the same way with the starting figure of 105% = £400.

Activity 11: Reverse percentage problems

Work out the original values in each question. Where rounding is required, round to two decimal places.

1. You buy a pair of trousers for £40. They have had a 20% discount applied. What was the original cost of the trousers?
2. The local gym has a special offer on that gives 35% off when you buy an annual pass. The amount you would pay for the year for the annual pass would be £120. How much would you have paid without the discount?
3. Your mobile phone provider has just put their prices up by 10%. You will now be paying £25 a month for your contract. How much were you paying before the increase?

Answer

1. 20% discount means that 80% of the cost is £40. Dividing each side by 80 gives 1% = 0.5.

   To get to 100% we multiply each side by 100 giving 100% = £50. Original cost = £50.
2. 35% discount means that 65% of the cost is £120. Dividing each side by 65 gives 1% = 1.84615….

   To get to 100% we multiply each side by 100 giving 100% = £184.62 (to two d.p.).
3. A 10% increase means that 110% of the cost is £25. Dividing each side by 110 gives 1% = 0.22727….

   To get to 100% we multiply each side by 100 giving 100% = £22.73 (to two d.p.).

Congratulations, you now know everything you need to know about percentages! As you have seen, percentages come up frequently in many different areas of life and having completed this section, you now have the skills and confidence to deal with all situations that involve them.

You saw at the beginning of the section that percentages are really just fractions. Decimals are also closely linked to both fractions and percentages. In the next section you will see just how closely related these three concepts are and also learn how to convert between each of them.

Summary

In this section you have learned:

- the connection between fractions and decimals and used this to enable you to calculate a percentage of an amount
- how to calculate percentage change using the formula
- ‘reverse percentages’ and practised using them in practical situations.

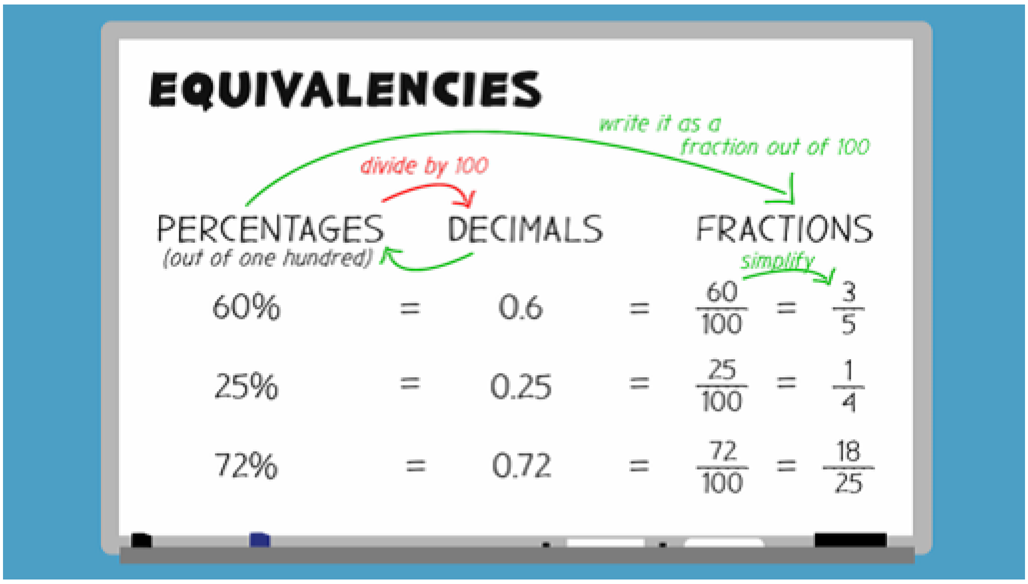
6 Fractions, decimals and percentages

You have already worked with decimals in this course and many times throughout your life. Every time you calculate something to do with money, you are using decimal numbers. You have also learned how to round a number to a given number of decimal places.

Figure 8 Equivalent decimals, fractions and percentages

Since fractions, decimals and percentages are all just different ways of representing the same thing, we can convert between them in order to compare. Take a look at the video below to see how to convert fractions, decimals and percentages.

Video content is not available in this format.



Activity 12: Matching fractions, decimals and percentages

Choose the correct fraction for each percentage and decimal.

Match each of the items above to an item below.

35% = 0.35 =

40% = 0.4 =

50% = 0.5 =

62.5% = 0.625 =

Fractions and percentages deal with splitting numbers into a given number of equal portions, or parts. When dealing with the next topic, ratio, you will still be splitting quantities into a given number of parts, but when sharing in a ratio, you do not share evenly. This might sound a little complicated but you'll have been doing it since you were a child.

Summary

In this section you have:

- learned about the relationship between fractions, decimals and percentages and are now able to convert between the three.

7 Ratio

As you can see from Figure 9, ratio is an important part of everyday life.

Figure 9 Day-to-day ratio

Ratio questions can be asked in different ways. There are three main ways of asking a ratio question. Take a look at an example of each below and see if you can identify the differences.

Type 1

A recipe for bread says that flour and water must be used in the ratio 5:3. If you wish to make 500 g of bread, how much flour should you use?

Type 2

You are growing tomatoes. The instructions on the tomato feed say ‘Use 1 part feed to 4 parts water’. If you use 600 ml of water, how much tomato feed should you use?

Type 3

Ishmal and Ailia have shared some money in the ratio 3:7. Ailia receives £20 more than Ishmal. How much does Ishmal receive?

Before discussing the differences in the types of question, it is important to understand how to tell which part of the ratio is which. If, for example, you have a group of men and women in the ratio of 5:4 – as the men were mentioned first, they are the first part of the ratio. This is the case in all ratio questions. The order that the items are written in the question directly relates to the order of the given ratio.

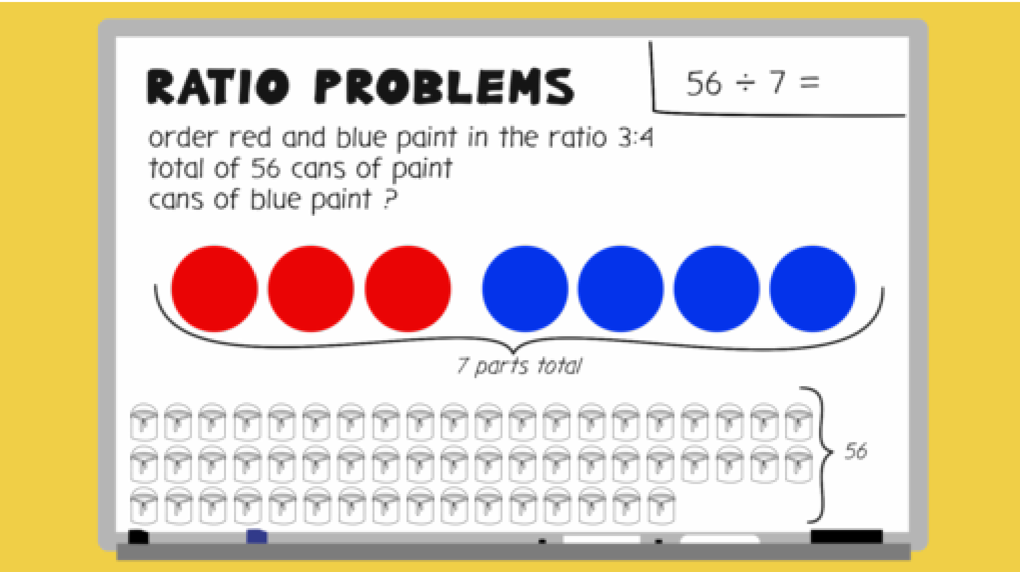
In questions of type 1, you are given the total amount that both ingredients must add to, in this example, 500 g. In questions of type 2 however, you are not given the total amount but instead are given the amount of one part of the ratio. In this case you know that the 4 parts of water total 600 ml.

The final type of ratio question does not give us either the total amount or the amount of one part of the ratio. Instead, it gives us just the difference between the first and second part of the ratio. Whilst neither type of ratio question is more complicated than the others, it is useful to know which type you are dealing with as the approach for solving each type of problem is slightly different.

7.1 Solving ratio problems where the total is given

The best way for you to understand how to solve these problems is to look through the worked example in the video below.

Video content is not available in this format.



Activity 13: Ratio problems where the total is given

Try solving these ratio problems:

1. To make mortar you need to mix soft sand and cement in the ratio 4:1. You need to make a total of 1500 g of mortar. How much soft sand will you need?
2. To make the mocktail ‘Sea Breeze’, you need to mix cranberry juice and grapefruit juice in the ratio 4:2. You want to make a total of 2700 ml of mocktail. How much grapefruit juice should you use?

Answer

1. Add the parts of the ratio:

$4 + 1 = 5$

Divide the total amount required by the sum of the parts of the ratio:

1500 g ÷ 5 = 300 g

Since soft sand is 4 parts, we do 300 g × 4 = 1200 g of soft sand.

2. Add the parts of the ratio:

   $4 + 2 = 6$

   Divide the total amount required by the sum of the parts of the ratio:

   2700 ml ÷ 6 = 450 ml

   Since grapefruit juice is 2 parts, we do 450 ml × 2 = 900 ml of grapefruit juice.

7.2 Solving ratio problems where the total of one part of the ratio is given

Take a look at the worked example below:

You are growing tomatoes. The instructions on the tomato feed say:

Use 1 part feed to 4 parts water

If you use 600 ml of water, how much tomato feed should you use?

These questions make much more sense if you look at them visually:

Figure 10 Solving ratio problems to grow tomatoes

You can now see clearly that 600 ml of water is worth 4 parts of the ratio. To find one part of the ratio you need to do:

600 ml ÷ 4 = 150 ml

Since the feed is only 1 part, feed must be 150 ml. If feed was more than one part you would multiply 150 ml by the number of parts.

Activity 14: Ratio problems with one part given

Practise your skills by tackling the ratio problems below:

1. A recipe requires flour and butter to be used in the ratio 3:5. The amount of butter used is 700 g. How much flour will be needed?
2. When looking after children aged between 7 and 10, the ratio of adults to children must be 1:8.

   a.

   For a group of 32 children, how many adults must there be?

   b.

If there was one more child in the group, how would this affect the number of adults required?

Answer

1. Flour:Butter

Figure 11 Using ratios in recipes

To find one part you do 700 g ÷ 5 = 140 g

To find the amount of flour needed you then do 140 g × 3 = 420 g flour.

2. (a)

Figure 12 Working out ratios of adults to children

To find one part you do 32 ÷ 8 = 4.

Since adults are only 1 part, you need 4 adults.

(b) If there were 33 children, one part would be 33 ÷ 8 = 4.125.

Since you cannot have 4.125 adults, you need to round up to 5 adults so you would need one more adult for 33 children.

7.3 Solving ratio problems where only the difference in amounts is given

Earlier in the section you came across the question below. Let's have a look at how we could solve this.

Ishmal and Ailia have shared some money in the ratio 3:7.

Ailia receives £20 more than Ishmal. How much does Ishmal receive?

Ishmal:Ailia

3:7

You know that the difference between the amount received by Ishmal and the amount received by Ailia is £20. You can also see that Ailia gets 7 parts of the money whereas Ishmal only gets 3.

The difference in parts is therefore 7 − 3 = 4. So 4 parts = £20.

Now this is established, you can work out the value of one part by doing:

£20 ÷ 4 = £5

As you want to know how much Ishmal received you now do:

£5 × 3 = £15

As an extra check, you can work out Ailia's by doing: £5 × 7 = £35

This is indeed £20 more than Ishmal.

Activity 15: Ratio problems where difference given

Now try solving this type of problem for yourself.

1. The ratio of female to male engineers in a company is 2:9. At the same company, there are 42 more male engineers than females. How many females work for this company?
2. A garden patio uses grey and white slabs in the ratio 3:5. You order 30 fewer grey slabs than white slabs. How many slabs did you order in total?

Answer

1. The difference in parts between males and females is $9 - 2 = 7$ parts.

   You know that these 7 parts = 42 people.

   To find 1 part you do:

   $42 \div 7 = 6$

   Now you know that 1 part is worth 6 people, you can find the number of females by doing

   $6 \times 2 = 12$ females
2. The difference in parts between grey and white is $5 - 3 = 2$ parts. These 2 parts are worth 30. To find 1 part you do:

   $30 \div 2 = 15$

   To find grey slabs do:

   $15 \times 3 = 45$

   To find white slabs do:

   $15 \times 5 = 75$

   Now you know both grey and white totals, you can find the total number of slabs by doing:

   $45 + 75 = 120$ slabs in total

Even though there are different ways of asking ratio questions, the aim of any ratio question is to determine the value of one part. Once you know this, the answer is simple to find!

Ratio can also be used in less obvious ways. Imagine you are baking a batch of scones and the recipe makes 12 scones. However, you need to make 18 scones rather than 12. How do you work out how much of each ingredient you need? The final ratio section deals with other applications of ratio.

7.4 Other applications of ratio

A very common and practical use of ratio is when you want to change the proportions of a recipe. All recipes state the number of portions they will make, but this is not always the number that you wish to make – you may wish to make more or less than the actual recipe gives. If you wanted to make 18 scones but only have a recipe that makes 12, how do you know how much of each ingredient to use?

To make 12 scones

400 g self-raising flour

1 tablespoon caster sugar

80 g butter

250 ml milk

Figure 13 Scones on a plate

As you already know the ingredients to make 12 scones, you need to know how much of each ingredient to make an extra 6 scones. Since 6 is half of 12, if you halve each ingredient, you will have the ingredients for the extra 6 scones. To find the total for 18 scones you need to add together the ingredients for the 12 scones and the 6 scones.

Table 4

12 scones	6 scones	18 scones
400 g flour	400 ÷ 2 = 200 g flour	400 g + 200 g = 600 g flour
1 tablespoon caster sugar	1 ÷ 2 = ½ tablespoon caster sugar	1 + ½ = 1 ½ tablespoons caster sugar
80 g butter	80 ÷ 2 = 40 g butter	80 g + 40 g = 120 g butter
250 ml milk	125 ml milk	250 ml + 125 ml = 375 ml milk

Have a go at the activity below to check your skills.

Activity 16: Ratio and recipes

1. This recipe makes 18 biscuits

    220 g self-raising flour

    150 g butter

    100 g caster sugar

    2 eggs

    How much of each ingredient is needed for 9 biscuits?

Answer

1. Since 9 is half of 18, you need to halve each ingredient to find the amount required to make 9 biscuits.

    220g ÷ 2 = 110 g flour

    150g ÷ 2 = 75 g butter

100g ÷ 2 = 50 g sugar

2 ÷ 2 = 1 egg

---

2. To make strawberry milkshake you need:

    630 ml milk

    3 scoops of ice cream

    240 g of strawberries

    The recipe serves 3

    How much of each ingredient is needed for 9 people?

Answer

2. You know the ingredients for 3 but want to know the ingredients for 9. Since 9 is three times as big as 3, you need to multiply each ingredient by 3.

    630 ml × 3 = 1890 ml milk

    3 × 3 = 9 scoops of ice cream

    240 g × 3 = 720 g of strawberries

---

3. Angel Delight recipe:

    Add 60 g powder to 300 ml cold milk

    Serves 2 people

    How much of each ingredient is needed to serve 5 people?

Answer

3. You know the ingredients for 2 people. You can find ingredients for 4 people by doubling the ingredients for 2. You then need ingredients for an extra 1 person. Since 1 is half of 2, you can halve the ingredients for 2 people.

    60 g + 60 g + 30 g = 150 g powder

    300 ml + 300 ml + 150 ml = 750 ml milk

The final practical application of ratio can be very useful when you are out shopping. Supermarkets often try and encourage us to buy in bulk by offering larger 'value' packs. But how can you work out if this is actually a good deal? Take a look at the example below.

Example: Ratio and shopping

Which of the boxes below offers the best value for money?

Figure 14 Shopping options: tea

Method

To work out which is the best value for money we need to find the price of 1 teabag.

If 40 teabags cost £1.20 then to find the cost of 1 teabag you do:

£1.20 ÷ 40 = £0.03, or 3p

If 240 teabags cost £9.60 then to find the cost of 1 teabag you do:

£9.60 ÷ 240 = £0.04, or 4p

The box containing 40 teabags is therefore better value than the larger box.

Activity 17: Practical applications of ratio

Use the activity below to practise your skills.

1. In each picture, work out which deal is the best value for money.
   a.

   Figure 15 Cola options

Answer

1.
   a.
      2 litres cost 64 p, so 1 litre costs 64 p ÷ 2 = 32p.3 litres cost 99p, so 1 litre costs 99p ÷ 3 = 33p.Comparing the cost of 1 litre in each case, we see that the 2-litre bottle is the best buy.

   b.

   Figure 16 Milk options

Answer

1.
   b.
      1 pint costs 26p. 4-pint carton costs 92p, so 1 pint costs 92p ÷ 4 = 23p. Comparing the cost of 1 pint of milk in each case, we see that the 4-pint carton is the best buy.

   c.

   Figure 17 Washing powder options

Answer

1.
   c.
      5 kg costs £10, so 1 kg costs £10 ÷ 5 = £2.2 kg cost £3, so 1 kg costs £3 ÷ 2 = £1.50. Comparing the cost of 1 kg of powder in each case, we see that the 2 kg box is the best buy.

2. Two supermarkets sell the same brand of juice. Shop B is offering 'buy one get second one half price' for apple juice and 'buy one get one free' for orange juice.

   For each type of juice which shop is offering the best deal?

   b.

   Figure 18 Apple juice options

Answer

2.

   b.

      Shop A: 1 litre costs 52pShop B: 2 litres cost 72p + 36p = 108p (here we pay 72p for the first litre and 36p for second litre), so 1 litre costs 108p ÷ 2 = 54p. Comparing the cost of 1 litre of apple juice in each case, we see that Shop A offers the better deal.

   b.

   Figure 19 Orange juice options

Answer

2.

   b.

      Shop A: 1 litre costs 39pShop B: 2 litres cost 76p (we get 1 litre free), so 1 litre costs: 76p ÷ 2 = 38p.Comparing the cost of 1 litre of orange juice in each case, we see that Shop B offers the better deal.

You have now completed all elements of the ratio section and hopefully are feeling confident with each topic.

The next section of the course deals with formulas. This might sound daunting but you have actually already used a formula. Remember when you learned about how to work out the percentage change of an item? To do that you used a simple formula and you will now take a closer look at slightly more complex formulas.

Summary

In this section you have:

- learned about the three different types of ratio problems and that the aim of any ratio problem is to find out how much one part is worth
- practised solving each type of ratio problem:
    - where the total amount is given
    -

  - where you are given the total of only one part
  - where only the difference in amounts is given
- learned about other useful applications of ratio, such as changing the proportions of a recipe.

8 Formulas

Figure 20 Formulas

Before diving in to this topic, you first need to learn about the order in which you need to carry out operations. Have you ever seen a question like the one below posted on social media?

Figure 21 A calculation using the four operations

There are usually a wide variety of answers given by various people. But how is it possible that such a simple calculation could cause so much confusion? It's all to do with the order in which you carry out the calculations.

If you go from left to right:

7 + 7 = 14

14 ÷ 7 = 2

2 + 7 = 9

9 × 7 = 63

63 − 7 = 56

The correct answer however, is actually 50. How do you arrive at this answer? You have to use the correct order of operations, sometimes called BIDMAS.

8.1 Order of operations

The order in which you carry out operations can make a big difference to the final answer. When doing any calculation that involves doing more than one operation, you must follow the rules of BIDMAS in order to arrive at the correct answer.

Figure 22 The BIDMAS order of operations

B: Brackets

Any calculation that is in brackets must be done first.

Example:

2 × (3 + 5)

2 × 8 = 16

Note that this could also be written as 2 (3 + 5) because if a number is next to a bracket, it means you need to multiply

I: Indices

After any calculations in brackets have been done, you must deal with any calculations involving indices or powers i.e.

$3^2 = 3 \times 3$

or

$4^3 = 4 \times 4 \times 4$

Example:

3×4^2

$3 \times (4 \times 4)$

$3 \times 16 = 48$

D: Divide

Next come any division or multiplication calculations. Of these two calculations, it does not matter which you do first.

Example:

$16 - 10 \div 5$

$16 - 2 = 14$

M: Multiply

Example:

$5 + 6 \times 2$

$5 + 12 = 17$

A: Add

Finally, any calculations involving addition or subtraction are done. Again, it does not matter which of these two are done first.

S: Subtract

Example:

24 + 10 − 2

34 − 2 = 32

or

24 + 8 = 32

Activity 18: Using BIDMAS

Now have a go at carrying out the following calculations yourself. Make sure you apply BIDMAS!

1. 4 + 3 × 2
2. 5 (4 − 1)
3. 36 ÷ 3^2
4. 7 + 15 ÷ 3 − 4

Answer

1. 4 + 6 = 10
2. 5 × 3 = 15
3. 36 ÷ 9 = 4
4. 7 + 5 − 4 = 8

Now that you have learned the rules of BIDMAS you are ready to apply them when using formulas.

8.2 Formulas in practice

You will already have come across and used formulas in your everyday life. For example, if you are trying to work out how long to cook a fresh chicken for you may have used the formula:

Time (minutes) = 15 + × 25 where '*w*' is the weight of the chicken in grams.

For example, if you wanted to cook a chicken that weighs 2500 g you would do:

Time (minutes) = 15 + × 25

Remembering to use BIDMAS you would then get:

Time (minutes) = 15 + 5 × 25
= 15 + 125
= 140 minutes

Let's look at another worked example before you try some on your own.

The owner of a guest house receives a gas bill. It has been calculated using the formula:

Cost of gas (£) =

Note: 8*d* means you do 8 × *d*.

Where *d* = number of days and *u* = number of units used

If she used 3500 units of gas in 90 days, how much is the bill?

In this example, *d* = 90 and *u* = 3500 so you do:

Cost of gas (£) =

=

=

= £42.20

Activity 19: Using formulas

1. Fuel consumption in Europe is calculated in litres per 100 kilometres. A formula to approximate converting from miles per gallon to litres per 100 kilometres is:

   L =

   Where *L* = number of litres per 100 kilometres and *M* = number of miles per gallon.

   A car travels 40 miles per gallon. What is this in litres per kilometres?
2. You can convert temperatures from degrees Fahrenheit to degrees Celsius by using the formula:

   C =

   Where *C* = temperature in degrees Celsius and *F* = temperature in degrees Fahrenheit.

   If the temperature is 104 degrees Fahrenheit, what is the temperature in degrees Celsius?

Answer

1. *L* = and in this case M = 40

   L =

L = 7 litres per 100 kilometres

2.

C = and in this case F = 104

C =

C =

C =

C = 40 degrees Celsius

Now that you have learned all the skills that relate to the number section of this course, there is just one final thing you need to be able to do before you will be ready to complete the end-of-session quiz for numbers.

You are now proficient at carrying out lots of different calculations including working out fractions and percentages of numbers, using ratio in different contexts and using formulas.

It is fantastic that you can now do all these things, but how do you check if an answer is correct? One way you can check would be to approximate an answer to the calculation (as you did in Section 2.2). Another way to check an answer is to use the inverse (opposite) operation.

Summary

In this section you have:

- learned about, and practised using BIDMAS – the order in which operations must be carried out
- seen examples of formulas used in everyday life and practised using formulas to solve a problem.

9 Checking your answers

Figure 23 Inverse operations

An inverse operation is an opposite operation. In a sense, it ‘undoes’ the operation that has just been performed. Let’s look at two simple examples to begin with.

Example: Check your working 1

6 + 10 = 16

Method

Since you have done an addition sum, the inverse operation is subtraction. To check this calculation, you can either do:

> 16 − 10 = 6
>
> or
>
> 16 − 6 = 10

You will notice here that the same 3 numbers (6, 10 and 16) have been used in all the calculations.

Example: Check your working 2

5 × 3 = 15

Method

This time, since you have done a multiplication sum, the inverse operation is division. To check this calculation, you can either do:

> 15 ÷ 5 = 3
>
> or
>
> 15 ÷ 3 = 5

Again, you will notice that the same 3 numbers (3, 5 and 15) have been used in all the calculations.

If you have done a more complicated calculation, involving more than one step, you simply ‘undo’ each step.

Example: Check your working 3

A coat costing £40 has a discount of 15%. How much do you pay?

Method

Firstly, we find out 15% of £40:

40 ÷ 100 × 15 = £6 discount

£40 − £6 = £34 to pay

To check this calculation, firstly you would check the subtraction sum by doing the addition:

£34 + £6 = £40

To check the percentage calculation, you then do:

£6 ÷ 15 × 100 = £40

You have now completed the number section of the course. Before moving on to the next session, ‘Units of measure’, complete the quiz on the following page to check your knowledge and understanding.

Summary

In this section you have:

- learned that each of the four operations has an inverse operation (its opposite) and that these can be used to check your answers
- seen examples and practised checking answers using the inverse operation.

10 Session 1 quiz

Now it's time to review your learning in the end-of-session quiz.

Session 1 quiz.

Open the quiz in a new window or tab (by holding ctrl [or cmd on a Mac] when you click the link), then return here when you have done it.

Although the quizzes in this course do not require you to show your working to gain marks, real exams would do so. We therefore encourage you to practise this by using a paper and pen to clearly work out the answers to the questions. This will also help you to make sure you get the right answer.

11 Session 1 summary

You have now completed Session 1, 'Working with numbers'. If you have identified any areas that you need to work on, please ensure you refer back to this section of the course and retry the activities.

You should now be able to:

- use the four operations to solve problems in context
- understand rounding and look at different ways of doing this
- solve equations involving negative numbers
- use fractions, decimals and percentages and convert between them
- solve different types of ratio problems
- use inverse operations to check your calculations.

All of the skills above will help you with tasks in everyday life. Whether you are at home or at work, number skills are an essential skill to have.

You are now ready to move on to Session 2, 'Units of measure'.

Session 2: Units of measure

Introduction

In this session you will be calculating using units of measure and focusing on length, time, weight, capacity and money. You will already be using these skills in everyday life when:

- working out which train you need to catch to get to your meeting on time
- weighing or measuring ingredients when cooking
- doing rough conversions if you are abroad to work out how much your meal costs in British pounds.

By the end of this session you will be able to:

- understand that there are different units used for measuring and how to choose the appropriate unit
- convert between measurements in the same system (e.g. grams and kilograms) and those in different systems (e.g. litres and gallons)
- use exchange rates to convert currencies
- work with time and timetables
- work out the average speed of a journey using a formula.

First watch the video below which introduces units of measure.

Video content is not available in this format.

1 Units of measure

A unit of measure is simply what you measure something in and you will already be familiar with using centimetres, metres, kilograms, grams, litres and millilitres for measurement. When measuring something, you need to choose the appropriate unit of measure for the item you are measuring. You would not, for example, measure the length of a room in millimetres. Have a go at the short activity below and choose the most appropriate unit for each example.

Activity 1: Choosing the unit

Millilitres (ml)

Metres (m)

Kilograms (kg)

Grams (g)

Centimetres (cm)

Litres (l)

Match each of the items above to an item below.

Amount of liquid in a glass

Length of a garden fence

Weight of a dog

Weight of an egg

Length of a computer screen

Amount of water in a paddling pool

Hopefully you found that activity fairly straightforward. Next you'll take a closer look at some units of measure and how to convert between them.

1.1 Converting units of measure in the same system

Imagine you are catering for a party and go to the wholesale shop to buy flour. You need 200 g of flour for each batch of cookies you will be making and need to make 30 batches. You can buy a 5 kg bag of flour but aren't sure if that will be enough.

In order to work out if you have enough flour, you need both measurements to be in the same unit – kg or g – before you can do the calculation. For units of measure that are in the same system (so you are not dealing with converting cm and inches for example) it's a simple process to convert one measurement into another. In most cases you will just need to multiply or divide by 10, 100 or 1,000. Take a look at the diagrams below which explain how to convert each type of measurement unit.

Length

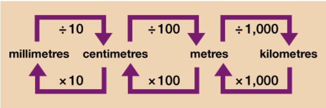


Figure 1 A conversion chart for length

Weight

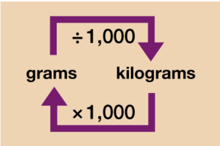


Figure 2 A conversion chart for weight

Money

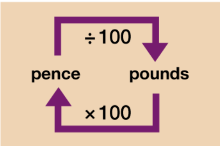


Figure 3 A conversion chart for money

Capacity

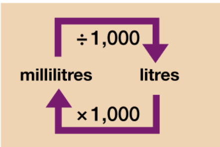


Figure 4 A conversion chart for capacity

You'll learn how to convert between different currencies and different units of measure (kilograms (kg) to pounds (lb) for example) later in this section. For now, have a go at the activity below and test your conversion skills along with your problem solving ones!

Activity 2: Solving conversion problems

1. A sunflower is 1.8 m tall. Over the next month, it grows a further 34 cm. How tall is the sunflower at the end of the month?
2. Peter is a long distance runner. In a training session he runs around the 400 m track 23 times. He wanted to run a distance of 10 km. How many more times does he need to run around the track to achieve this?

3. A water cooler comes with water containers that hold 12 l of water. The cups provided for use hold 150 ml. A company estimates that each of its 20 employees will drink 2 cups of water a day. How many 12 l bottles will be needed for each working week (Monday to Friday)?
4. David is a farmer and has 52 goats. He is given a bottle of wormer that contains 0.3 litres. The bottle comes with the instructions:

   'Use 4 ml of wormer for each 15 kg of body weight.'

   The average weight of David's goats is 21 kg and he wants to treat all of them. Does David have enough wormer?

Answer

1. 1 m = 100 cm so 1.8 × 100 = 180 cm

   180 cm + 34 cm = 214 cm or 2.14 m

2. 400 m × 23 = 9200 m that Peter has run.

   1 km = 1,000 m so, 10 km = 10 × 1,000 = 10,000 m

   The difference between what Peter wants to run and what he has already run is:

   10,000 – 9,200 = 800 m

   800 ÷ 400 = 2

   Peter needs to run another 2 laps of the track.

3. 1 litre = 1,000 ml so 12 l = 12 × 1,000 = 12,000 ml

   Each employee will drink 2 × 150 ml = 300 ml a day

   There are 20 employees so 300 × 20 = 6,000 ml for all employees per day

   A working week is 5 days:

   6,000 × 5 = 30,000 ml for all employees for the week

   30,000 ÷ 12,000 = 2.5

   They will need 2 and a half containers per week.

4. 1 litre = 1,000 ml so 0.3 litres = 0.3 × 1,000 = 300 ml of wormer in the bottle

   52 goats at 21 kg each is 52 × 21 = 1092 kg total weight of goats

   To find the number of 4 ml doses required do:

   1092 ÷ 15 = 72.8

   72.8 × 4 ml = 291.2 ml of wormer needed.

   Yes, David has enough wormer.

Hopefully you will now be feeling confident with converting units of measure within the same system. You'll need to know how to do this and be able to remember how to convert from one to another by multiplying or dividing.

If you are being asked to convert between litres and gallons or US dollars and British pounds however, you won't be expected to know the conversion rate, you'll be given it in the question. The next section will show you how to use these conversion rates and you'll be able to practise solving problems that require you to do this.

Summary

In this section you have learned:

- that different units are used for measurement
- unit selection depends on the item or object being measured
- how to convert between units in the same system.

2 Converting currencies and measures between different systems

When working with measures you'll often need to be able to convert between units that are in different systems (kilograms to pounds for example) or currencies (British pounds to Euros for example). Whilst this might sound tricky, it's really just using your multiplication and division skills. Let's begin by looking at converting currencies.

2.1 Converting currencies

Often when you are abroad, or buying something from the internet from another country, the price will be given in a different currency. You'll want to be able to work out how much the item costs in your own currency so that you can make a decision about whether to buy the item or not. Let's look at an example.

Figure 5 Different currency notes

Example: Pounds and euros

a. You are in Spain and want to buy a souvenir. The price is €35 (35 euros). You know that:

   £1 = €1.15

   Method

   Look at the diagram below. In order to get from 1 to 1.15, you must multiply by 1.15. Following that, to get from 1.15 to 1, you must divide by 1.15.

   In order to go from pounds to euros then, you multiply by 1.15 and to convert from euros to pounds, you divide by 1.15.

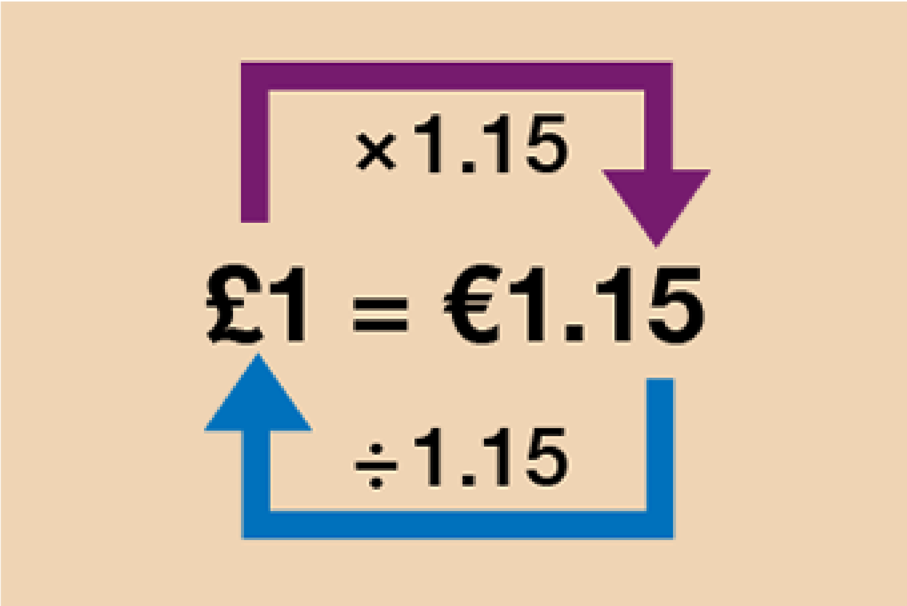


Figure 6 A conversion rate for pounds and euros

Since the souvenir costs €35, you do:

€35 ÷ 1.15 = £30.43 (rounded to two decimal places)

b. You are at the airport on the way back from your holiday and have £50 cash left. You want to buy some aftershave that costs €58. Can you afford it? You know that:

£1 = €1.15

Method

Referring back to the diagram above, you want to convert pounds to euros in this example so you must multiply by 1.15. You do:

£50 × 1.15 = €57.50

This means you cannot afford the aftershave.

Before you try some for yourself, let's look at one more example. This time involving pounds and dollars.

Example: Pounds and dollars

a. You want to buy an item from America. The cost is $120. You know that £1 = $1.30. How much does the item cost in pounds?

Similarly to before, you can see from the diagram that in order to go from dollars to pounds you must divide by 1.30.

Figure 7 A conversion rate for pounds and dollars

To work out $120 in pounds then, you do:

$120 ÷ 1.30 = £92.31 (rounded to two decimal places)

b. You are sending a relative in America £20 for their birthday. You need to send the money in dollars. How much should you send?

To convert from pounds to dollars, you need to multiply by 1.30. So to change £20 into dollars you do:

£20 × 1.30 = $26

You need to send $26.

Activity 3: Currency conversions

1. Sarah sees a handbag for sale on a cruise ship for €80. She sees the same handbag online for £65. She wants to pay the cheapest possible price for the bag. On that day the exchange rate is £1 = €1.25. Where should she buy the bag from?
2. Josh is going to South Africa and wants to change £250 into rand. He knows that £1 = 18.7 rand. How many rand will he get for his money?
3. Alice is returning from America and has $90 left over to change back into £s. Given the exchange rate of £1 = $1.27, how many £s will Alice receive? Give your answer rounded to two decimal places.

Answer

1. For this question you can either convert from £ to € or from € to £.

   Converting from £ to €:

   £65 × 1.25 = €81.25

   Sarah should buy the bag on the ship.

   Converting from € to £:

€80 ÷ 1.25 = £64

Sarah should buy the bag on the ship.

2. You need to convert from £ to rand so you do:

   £250 × 18.7 = 4675 rand

3. You need to convert from $ to £ so you do $90 ÷ 1.27 = £70.87 (rounded to two d.p.).

Hopefully you are now feeling confident with converting between currencies. The next part of this section deals with converting other units of measure between different systems – centimetres to inches, pounds to kilograms etc. These conversions are incredibly similar to converting currency and the conversion rate will always be given to you so it's not something you have to remember.

2.2 Converting units of measure between different systems

This is a useful skill to have because you may often measure something in one unit, say your height in feet and inches, but then need to convert it to centimetres. You may, for example, be training to run a 10 km race and want to know how many miles that is. To do this all you need to know is the conversion rate and then you can use your multiplication and division skills to calculate the answer.

When performing these conversions, you are converting between metric and imperial measures. Metric measures are commonly used around the world but there are some countries (the USA for example) who still use imperial units. Whilst the UK uses metric units (g, kg, m, cm etc.) there are some instances where you may still need to convert a metric measure to an imperial one (inches, feet, gallons etc.).

In most cases, the conversion rate will be given in a similar format to the way money exchange rates are given, i.e. 1 inch = 2.5 cm or 1 kg = 2.2 lb. In these cases you can do exactly the same as you would with a currency conversion. The only exceptions here are where you don't have one of the units of measure as a single unit i.e. 5 miles = 8 km.

As this skill is very similar to the one you previously learnt with currency conversions, let's just look at two brief examples before you have a go at an activity for yourself.

Example: Centimetres and inches

You want to start your own business making accessories. One of the items you will be making is tote bags. The material you have bought is 156 cm wide. You need to cut pieces of material that are 15 inches wide.

How many pieces can you cut from the material you bought?

Use 1 inch = 2.54 cm.

Method

You need to start by converting either cm to inches or inches to cm so that you are working with units in the same system. Let's look at both ways so that you feel confident that you will get the same answer either way.

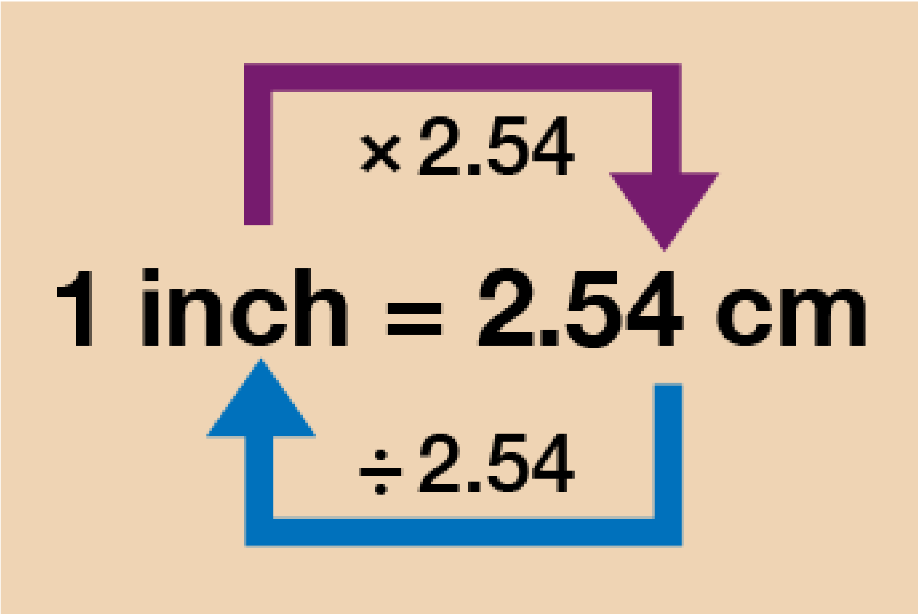


Figure 8 Converting between inches and centimetres

You can see from the diagram above that to convert from inches to cm you must multiply by 2.54. To convert from cm to inches you must divide by 2.54.

Converting inches to cm then:

> 15 inches × 2.54 = 38.1 cm. This is the length of the material needed for each bag.

To calculate how many pieces of material you can cut you then do:

> 156 ÷ 38.1 = 4.0944…. As you need whole pieces of material, you need to round this answer down to 4 pieces.

Converting from cm to inches:

> 156 ÷ 2.54 = 61.417…, this is the length of the big piece of material.

To calculate how many pieces of material you can cut you then do:

> 61.417… ÷ 15 = 4.0944…. Again, as you need whole pieces of material, you need to round this answer down to 4 pieces.

You can see that no matter which way you choose to convert you will arrive at the same answer.

Example: Kilometres and miles

You have signed up for a 60 km bike ride. There is a lake in a nearby park that you want to use for your training. You know that one lap of the lake is 2 miles. You want to cycle a distance of at least 40 km in your last training session before the race. How many full laps of the lake should you do?

You know that a rough conversion is 5 miles = 8 km.

There is more than one way to go about this calculation and, as ever, if you have a different method that works for you and you arrive at the same answer, feel free to use it!

Method

Since you already know how to convert if you are given a conversion that has a single unit of whichever measure you are using, it makes sense to just change the given conversion into one that you are used to dealing with.

Look at the diagram below – since you know that 5 miles is worth 8 km, you can find out what 1 mile is worth by simply dividing 5 by 5 so that you arrive at 1 mile. Whatever you do to one side, you must do to the other. Therefore, you also do 8 divided by 5. This then gives 1 mile = 1.6 km.

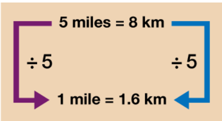


Figure 9 Calculating 1 mile in kilometres

Now that you know 1 mile = 1.6 km, you can solve this problem in its usual way:

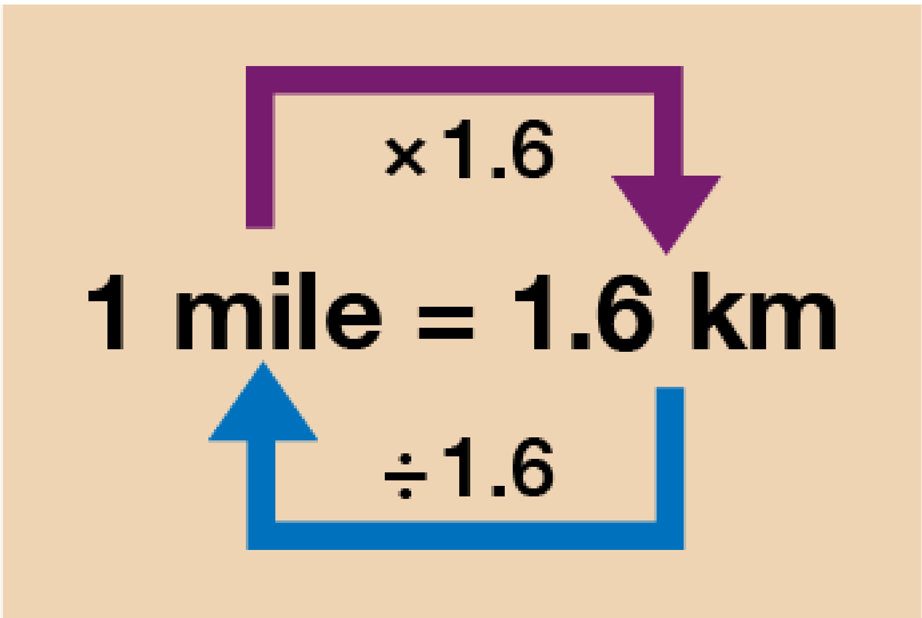


Figure 10 Converting between miles and kilometres

Since you first want to know what 40 km is in miles you need to divide by 1.6:

$$40 \div 1.6 = 25 \text{ miles}$$

As each lap of the lake is 2 miles you then need to divide 25 miles by 2 to find the total number of laps you need to complete:

$$25 \div 2 = 12.5 \text{ laps}$$

Therefore, you will need to cycle 12.5 laps around the lake in order to have cycled your target of 40 km.

Now that you have seen a couple of worked examples, have a go at the activity below to check your understanding.

Activity 4: Converting between systems

1. A Ford Fiesta car can hold 42 litres of petrol. Using the fact that 1 gallon = 4.54 litres, work out how many gallons of petrol the car can hold. Give your answer rounded to two decimal places.
2. The café you work at has run out of milk and you have been asked to go to the shop and buy 10 pints. When you arrive however, the milk is only available in 2 litre bottles. You know that 1 litre = 1.75 pints. How many 2 litre bottles should you buy?
3. You are packing to go on holiday and are allowed 25 kg of luggage on the flight. You've weighed your case on the bathroom scales and it weighs 3 stone and 3 pounds.

   You know that:

   1 stone = 14 pounds2.2 pounds = 1 kg

   Is your luggage over the weight limit?

Answer

1. As you want to convert from litres to gallons you will need to divide by 4.54. You do:

   42 ÷ 4.54 = 9.25 to two d.p.
2. Firstly, you want to know how many litres there are in 10 pints, so you need to convert from pints to litres. You do:

   10 ÷ 1.75 = 5.71… litres. As you can only buy the milk in 2 litre bottles, you will have to buy 6 litres of milk in total. You therefore need:

   6 ÷ 2 = 3 bottles of milk
3. Firstly, you need to convert 3 stone and 3 pounds into just pounds. Since 1 stone = 14 pounds, to work out 3 stone you do:

   3 × 14 = 42 pounds

   Then you need to add on the extra 3 pounds, so in total you have 42 + 3 = 45 pounds.

   Now that you know this, you can convert from pounds to kg.

   Since 2.2 pounds = 1 kg, you can also say that 1 kg = 2.2 pounds (this doesn't change anything, it just makes it a little easier as you can stick to your usual method of having the single unit on the left hand side).

   To convert from pounds to kg then, you divide by 2.2 and so you have:

   45 ÷ 2.2 = 20.45 kg.

   Yes, your luggage is within the weight limit.

You should now be feeling confident with your conversion skills so it's time to move on to the next part of this session.

Summary

In this section you have learned:

- that different systems of measurement can be used to measure the same thing (e.g. a cake could be weighed in either grams or pounds)
- you can convert between these systems using your multiplication and division skills and the given conversion rate
- currencies can be converted in the same way as long as you know the exchange rate – this is particularly useful for holidays.

3 Time, timetables and average speed

Calculating with time is often seen as tricky, not surprising really considering how difficult it can be to learn how to tell the time. The reason many people find calculating with time tricky is because, unlike nearly every other mathematical concept, it does not work in 10s. Time works in 60s – 60 seconds in a minute, 60 minutes in an hour. You cannot therefore, simply use your calculator to add on or subtract time.

Figure 11 A radio alarm clock

Think about this simple example. If it's 9:50 and your bus takes 20 minutes to get to work, you cannot work out the time you will arrive by doing 950 + 20 on your calculator. This would give you an answer of 970 or 9:70 – there isn't such a time!

You will need to calculate with time and use timetables in daily life to complete basic tasks such as: getting to work on time, working out which bus or train to catch, picking your children up from school on time, cooking and so many other daily tasks.

3.1 Calculating with time and timetables

As previously discussed, calculators are not the most useful items when it comes to calculations involving time. A much better option, is to use a number line to work out these calculations. Take a look at the examples below.

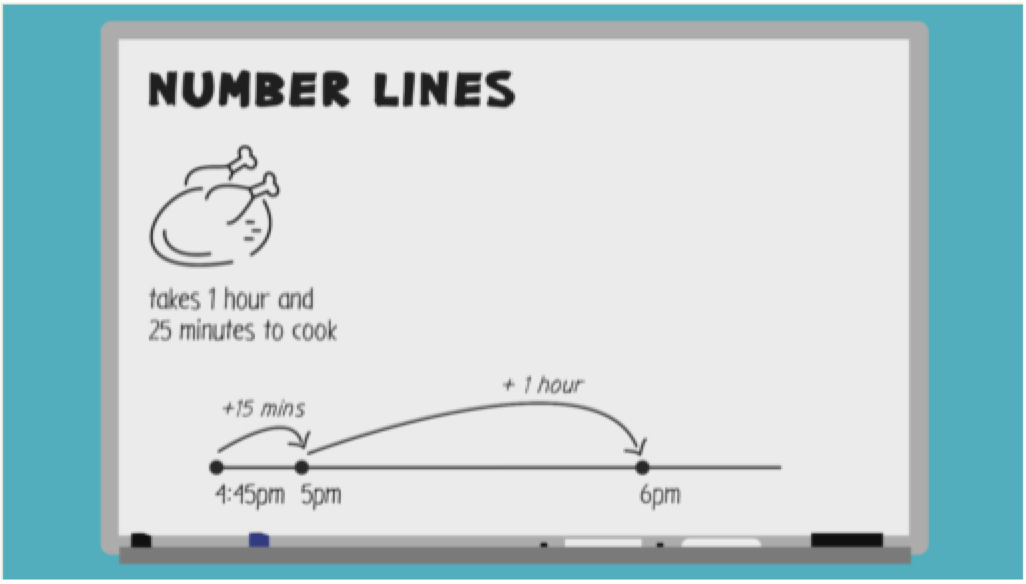
Example: Cooking

You put a chicken in the oven at 4:45 pm. You know it needs to cook for 1 hour and 25 minutes. What time should you take the chicken out?

Method

Watch the video below to see how the number line method works.

Video content is not available in this format.



Example: Time sheets

You work for a landscaping company and need to fill out your time sheet for your employer. You began working at 8:30 am and finished the job at 12:10 pm. How long did the job take?

Method

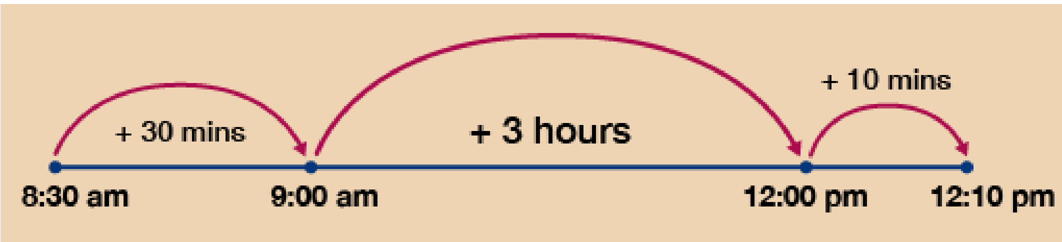


Figure 12 A number line for a time sheet

Again, for finding the time difference you want to work with easy 'chunks' of time. Firstly, you can move from 8:30 am to 9:00 am by adding 30 minutes. It is then simple to get to 12:00 pm by adding on 3 hours. Finally, you just need another 10 minutes to take you to 12:10 pm. Looking at the total time added you have 3 hours and 40 minutes.

Another aspect of calculating with time comes in the form of timetables. You will be used to using these to work out which departure time you need to make in order to get to a location on time or how long a journey will take. Once you can calculate with time, using timetables simply requires you to find the correct information before carrying out the calculation. Take a look at the example below.

Example: Timetables

Here is part of a train timetable from Swindon to London.

Table 1(a)

Swindon	06:10	06:27	06:41	06:58	07:01	07:17
Didcot	06:27	06:45	06:58	07:15	07:18	07:34
Reading	06:41	06:59	07:13	-	07:33	-
London	07:16	07:32	07:44	08:02	08:07	08:14

a. You need to travel from Didcot to London. You need to arrive in London by 8:00 am. What is the latest train you can catch from Didcot to arrive in London for 8:00 am?

Method

Table 1(b)

Swindon	06:10	06:27	06:41	06:58	07:01	07:17
Didcot	06:27	06:45	*06:58*	07:15	07:18	07:34
Reading	06:41	06:59	07:13	-	07:33	-
London	07:16	07:32	**07:44**	08:02	08:07	08:14

Looking at the arrival times in London, in order to get there for 8:00 am you will need to take the train that arrives in London at 07:44 (highlighted with bold). If you then move up this column of the timetable you can see that this train leaves Didcot at 06:58 (highlighted with italic). This is therefore the train you must catch.

b. How long does the 06:58 from Swindon take to travel to London?

Method

Table 1(c)

Swindon	06:10	06:27	06:41	*06:58*	07:01	07:17
Didcot	06:27	06:45	06:58	07:15	07:18	07:34
Reading	06:41	06:59	07:13	-	07:33	-
London	07:16	07:32	07:44	**08:02**	08:07	08:14

Firstly, find the correct train from Swindon (highlighted with italic). Follow this column of the timetable down until you reach London (highlighted with bold). You then need to find the difference in time between 06:58 and 08:02. Using the number line method from earlier in the section (or any other method you choose).

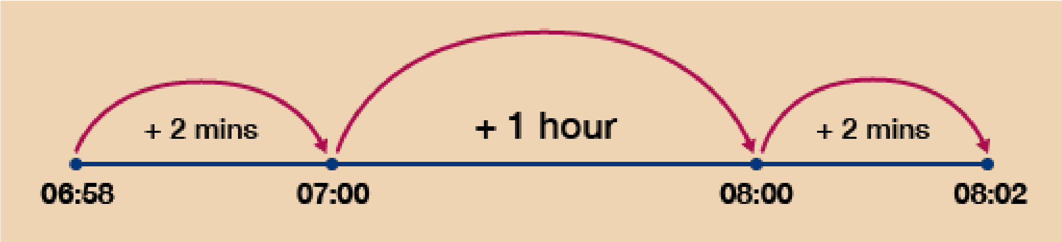


Figure 13 A number line for a timetable

You can then see that this train takes a total of 1 hour and 4 minutes to travel from London to Swindon.

Have a go at the activity below to practise calculating time and using timetables.

Activity 5: Timetables and calculating time

1. Kacper is a builder. He leaves home at 8:30 am and drives to the trade centre. He collects his items and loads them into his van. His visit takes 1 hour and 45 minutes. He then drives to work, which takes 50 minutes. What time does he arrive at work?
2. You have invited some friends round for dinner and find a recipe for roast lamb. The recipe requires:
   - 25 minutes preparation time
   - 1 hour cooking time
   - 20 minutes resting time

   You want to eat with your friends at 7:30 pm. What is the latest time you can start preparing the lamb?
3. Here is part of a train timetable from Manchester to Liverpool.

Table 2(a)

	Manchester to Liverpool					
Manchester	10:24	10:52	11:03	11:25	12:01	12:13
Warrington	10:38	11:06	11:20	11:45	12:15	12:28
Widnes	10:58	11:26	11:42	12:03	12:34	12:49
Liverpool Lime Street	11:09	11:38	11:53	12:14	12:46	13:02

You need to travel from Manchester to Liverpool Lime Street. You need to be in Liverpool by 12:30. Which train should you catch from Manchester and how long will your journey take?

Answer

1. Firstly, work out the total time that Kacper is out for:

1 hour 45 minutes at the trade centre and another 50 minutes driving makes a total of 2 hours and 35 minutes.

Then, using the number line, you have:

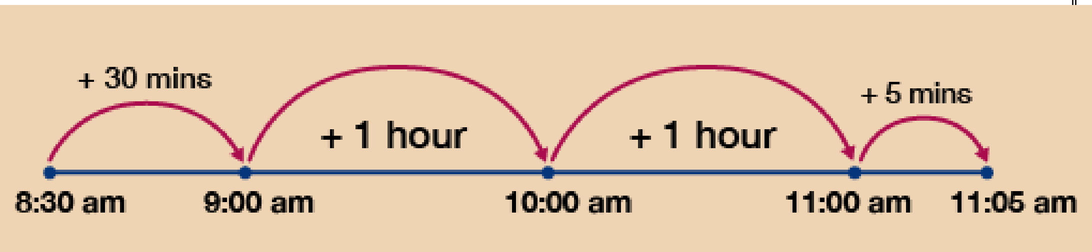


Figure 14 A number line for Question 1

So Kacper arrives at work at 11:05 am.

2. Again, firstly work out the total time required:

   25 minutes + 1 hour + 20 minutes = 1 hour 45 minutes in total

   This time you need to work backwards on the number line so you begin at 7:30 and work backwards.

Figure 15 A number line for Question 2

You can now see that you must begin preparing the lamb at 5:45 pm at the latest.

3. Looking at the timetable for arrival at Liverpool, you can see that in order to arrive by 12:30 you need to catch the train that arrives at 12:14. This means that you need to catch the 11:25 from Manchester.

Table 2(b)

Manchester to Liverpool						
Manchester	10:24	10:52	11:03	*11:25*	12:01	12:13
Warrington	10:38	11:06	11:20	11:45	12:15	12:28
Widnes	10:58	11:26	11:42	12:03	12:34	12:49
Liverpool Lime Street	11:09	11:38	11:53	**12:14**	12:46	13:02

You therefore need to work out the difference in time between 11:25 (italic) and 12:14 (bold).

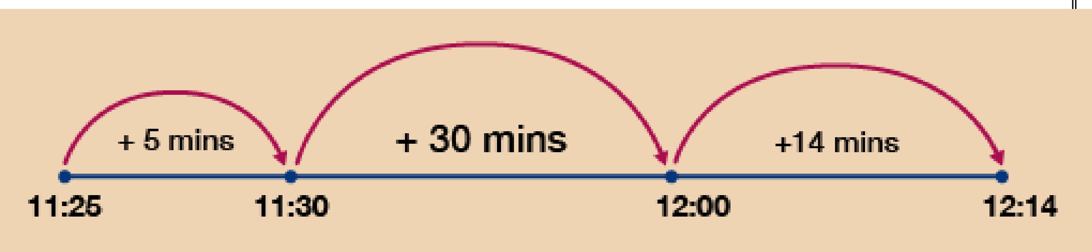


Figure 16 A number line for Question 3

Using the number line again, you can see that this is a total of 5 + 30 + 14 = 49 minutes.

You should now be feeling comfortable with calculations involving time and timetables. Before you move on to looking at problems that involve average speed, it is worth taking a brief look at time conversions. Since you are already confident with converting units of measure, this part will just consist of a brief activity so that you can practise converting units of time.

3.2 Converting units of time

You can see from the diagram below that to convert units of time you can use a very similar method to the one you used when converting other units of measure. There is one slight difference when working with time however.

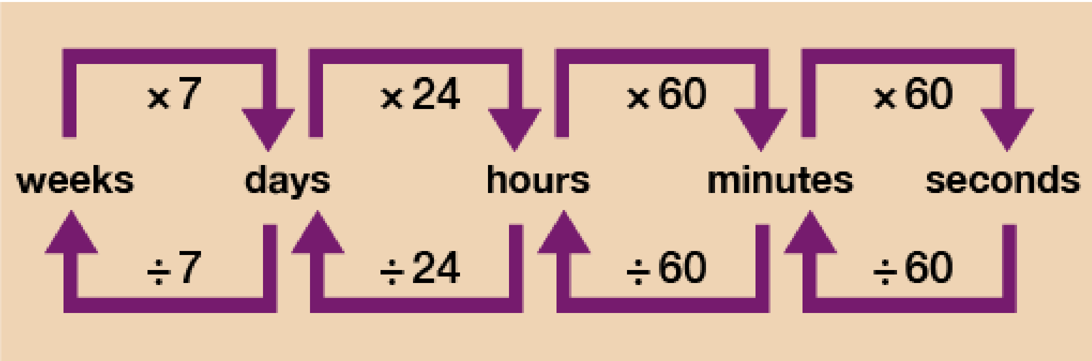


Figure 17 A conversion chart for time

Let's say you want to work out how long 245 minutes is in hours. The diagram above shows that you should do 245 ÷ 60 = 4.083. This is not a particularly helpful answer since you really want the answer in the format of: ___ hours __ minutes. Due to the fact that time does not work in 10s, you need to do a little more work once arriving at your answer of 4.083.

The answer is obviously 4 hours and an amount of minutes.

4 hours then is 4 × 60 = 240 minutes.

Since you wanted to know how long 245 minutes is you just do 245 – 240 = 5 minutes left over. So 245 minutes is 4 hours and 5 minutes.

It's a very similar process if you want to go from say minutes to seconds. Let's take it you want to know how long 5 minutes and 17 seconds is in seconds. 5 minutes would be 5 × 60 = 300 seconds. You then have a further 17 seconds to add on so you do 300 + 17 = 317 seconds.

Have a go at the activity below to make sure you feel confident with converting times.

Activity 6: Converting times

Convert the following times:

a. 6 hours and 35 minutes = ___ minutes.

b. 85 minutes = ____ hours and ____ minutes.

c. 153 seconds = ____ minutes and ___ seconds.

d. 46 days = ___ weeks and ____days.
e. 3 minutes and 40 seconds = ____ seconds.

Answer

a. 6 hours = 6 × 60 = 360 minutes
360 minutes + 35 minutes = 395 minutes

b. 85 minutes ÷ 60 = 1.416
1 hour = 60 minutes.
85 minutes − 60 minutes = 25 minutes remaining
So 85 minutes = 1 hour and 25 minutes

c. 153 seconds ÷ 60 = 2.55
2 minutes = 2 × 60 = 120 seconds
153 seconds − 120 seconds = 33 seconds remaining
So 153 seconds = 2 minutes and 33 seconds

d. 46 days ÷ 7 = 6.571…
6 weeks = 6 × 7 = 42 days
46 days − 42 days = 4 days remaining
So 46 days = 6 weeks and 4 days

e. 3 minutes = 3 × 60 = 180 seconds
180 seconds + 40 seconds = 220 seconds

Hopefully you found that activity fairly straightforward and are now feeling ready to move on to the last part of the 'Units of measure' session – Average speed.

3.3 Average speed

Figure 18 A speed camera sign

You've probably seen one of these signs whilst travelling along the motorway through roadworks. Perhaps you were in an average speed check zone of 50 mph and found your speed had crept up to 55 mph – what do you do? Slow down! If you only slow down to the speed limit of 50 mph however, you may well find that you are still over the average speed limit! This is just one example of where average speed comes up in our daily lives.

Being able to calculate and use average speed can help you to work out how long a journey is likely to take or, in the case of the example above, how much you need to slow down by in order not to exceed the average speed limit! The method for working out average speed involves using a simple formula.

Figure 19 A formula for average speed

You can also use this formula to work out the distance travelled when given a time and the average speed, or the time taken for a journey when given the distance and average speed.

The formulas for this are shown in the diagram below.

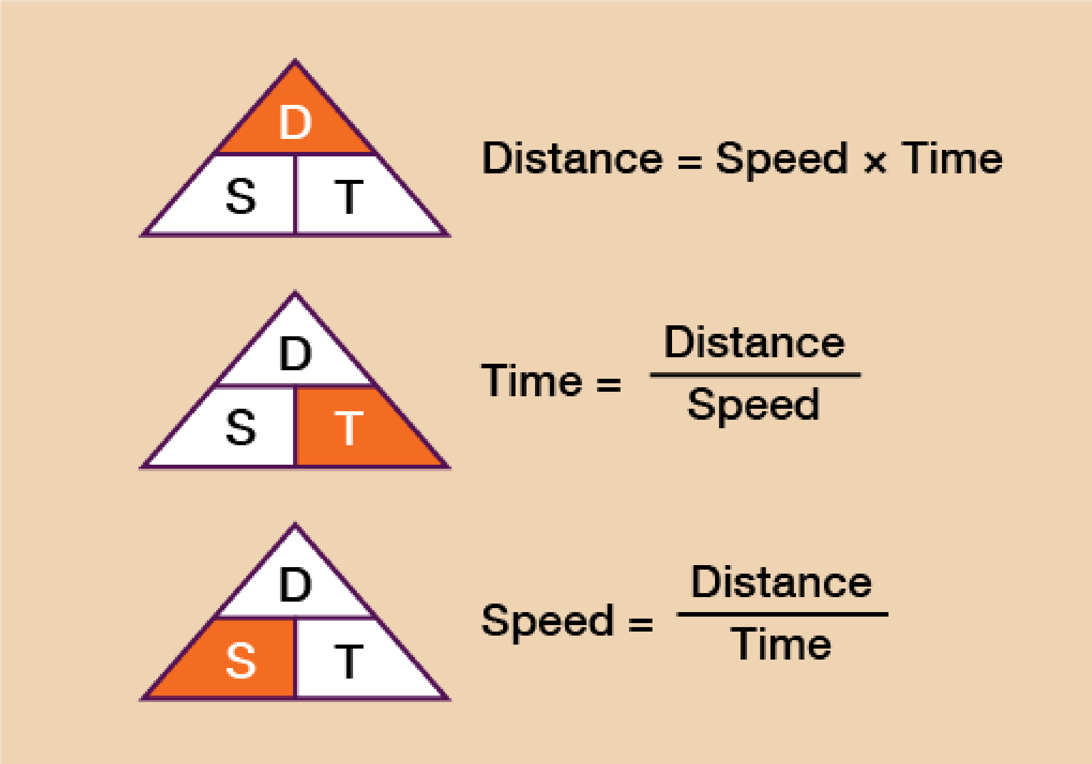


Figure 20 Distance, speed and time formulas

You can see that when given any two of the elements from distance, speed and time, you will be able to work out the third. Let's look at an example of each so that you can familiarise yourself with it.

Example: Calculating distance

A car has travelled at an average speed of 52 mph over a journey that lasts 2 and a half hours. What is the total distance travelled?

Method

You can see that to work out the distance you need to do speed × time. In this example then we need to do 52 × 2.5. It is very important to note here that 2 and a half hours must be written as 2.5 (since 0.5 is the decimal equivalent of a half).

You cannot write 2.30 (for 2 hours and 30 mins). If you struggle to work out the decimal part of the number, convert the time into minutes (2 and a half hours = 150 minutes) and then divide by 60 (150 ÷ 60 = 2.5).

$$52 \times 2.5 = 130 \text{ miles travelled}$$

Example: Calculating time

A train will travel a distance of 288 miles at an average speed of 64 mph. How long will it take to complete the journey?

Method

You can see from the formula that to calculate time you need to do distance ÷ speed so you do:

$$288 \div 64 = 4.5 \text{ hours}$$

Again, note that this is not 4 hours 50 minutes but 4 and a half hours.

If you are unsure of how to convert the decimal part of your answer, simply multiply the answer by 60, this will turn it into minutes and you can then convert from there.

Example: Calculating speed

A Formula One car covers a distance of 305 km during a race. The time taken to finish the race is 1 hour and 15 minutes. What is the car's average speed?

Method

The formula tells you that to calculate speed you must do distance ÷ time. Therefore, you do 305 ÷ 1.25 (since 15 minutes is a quarter of an hour and 0.25 is the decimal equivalent of a quarter):

$$305 \div 1.25 = 244 \text{ km/h}$$

In a similar way to example 1, if you are unsure of how to work out the decimal part of the time simply write the time (in this case 1 hour and 15 minutes) in minutes, (1 hour 15 minutes = 75 minutes) and then divide by 60:

$$75 \div 60 = 1.25$$

Before moving on to the end-of-session quiz, have a go at the following activity to check that you feel confident with finding speed, distance and time.

Activity 7: Calculating speed, distance and time

1. Filip is driving a bus along a motorway. The speed limit is 70 mph. In 30 minutes, he travels a distance of 36 miles. Does his average speed exceed the speed limit?
2. A plane flies from Frankfurt to Hong Kong. The flight time was 10 hours and 45 minutes. The average speed was 185 km/h. What is the distance flown by the plane?

3. Malio needs to get to a meeting by 11:00 am. The time now is 9:45 am. The distance to the meeting is 50 miles and he will be travelling at an average speed of 37.5 mph. Will he be on time for the meeting?

Answer

1. You need to find the speed so you do: distance ÷ time.

   The distance is 36 miles. The time is 30 minutes but you need the time in hours:

   30 minutes ÷ 60 = 0.5 hours

   Now you do:

   36 ÷ 0.5 = 72 mph

   Yes, Filip's average speed did exceed the speed limit.

2. You need to find the distance so you do:

   speed × time

   10 hours 45 minutes = 10.75 hours

   (If you are unsure, convert to minutes: 10 hours 45 minutes = 645 minutes, then divide by 60: 645 ÷ 60 = 10.75)

   speed × time = 185 × 10.75 = 1988.75 km from Frankfurt to Hong Kong

3. You need to find the time so you do:

   distance ÷ speed

   50 ÷ 37.5 = 1.3

   To covert this to minutes do:

   1. × 60 = 80 minutes

   80 minutes = 1 hour and 20 minutes

   No, Malio will not make the meeting on time.

Note: An answer of 1., means 1.3333333 (the 3 is recurring or never ending). It is conventional to write the digit that recurs with a dash above it.

Summary

In this section you have learned:

- how to use timetables to plan a journey and how to calculate time efficiently
- how to convert between units of time by using multiplication and division skills
- how to use the formula for calculating distance, speed and time.

4 Session 2 quiz

Now it's time to review your learning in the end-of-session quiz.

Session 2 quiz.

Open the quiz in a new window or tab (by holding ctrl [or cmd on a Mac] when you click the link), then return here when you have done it.

5 Session 2 summary

You have now completed Session 2, ‘Units of measure’. If you have identified any areas that you need to work on, please ensure you refer to this section of the course and retry the activities.

You should now be able to:

- understand that there are different units used for measuring and how to choose the appropriate unit
- convert between measurements in the same system (e.g. grams and kilograms) and those in different systems (e.g. litres and gallons)
- use exchange rates to convert currencies
- work with time and timetables
- work out the average speed of a journey using a formula.

All of the skills listed above will help you with tasks in everyday life, such as measuring for new furniture or redesigning a room or garden. These are essential skills that will help you progress through your employment and education.

You are now ready to move on to Session 3, ‘Handling data’.

Session 3: Handling data

Introduction

Maths is relevant to so many aspects of our everyday lives and you should now be feeling confident with using numbers, measuring and calculating with money and units of time.

This session focuses on data. We all use and generate data on a daily basis – companies use it to track our shopping and lifestyle habits and offer us personalised deals and you may well collect data as part of your job to find out which item is selling best, how many clients/patients are satisfied with the services provided or to identify areas that need improvement.

Data is a big part of our lives and can be represented in many different ways. This session will take you through a number of these representations and show you how to interpret data to find specific information.

By the end of this session you will be able to:

- identify the two different types of data and where they are used
- create and use tally charts, frequency tables and data collection sheets to record information
- draw and interpret bar charts, pie charts and line graphs
- understand there are different types of averages and be able to calculate each type
- understand that probability is about how likely an event is to happen and the different ways that it can be expressed.

Before delving into the world of charts, graphs and averages it is important to make the distinction between the two different types of data – discrete and continuous.

Video content is not available in this format.

1 Discrete and continuous data

Discrete data is information that can only take certain values. These values don't have to be whole numbers (a child might have a shoe size of 3.5 or a company may make a profit of £3456.25 for example) but they are fixed values – a child cannot have a shoe size of 3.72!

The number of each type of treatment a salon needs to schedule for the week, the number of children attending a nursery each day or the profit a business makes each month are all examples of discrete data. This type of data is often represented using tally charts, bar charts or pie charts.

Continuous data is data that can take any value. Height, weight, temperature and length are all examples of continuous data. Some continuous data will change over time; the weight of a baby in its first year or the temperature in a room throughout the day. This data is best shown on a line graph as this type of graph can show how the data changes over a given period of time. Other continuous data, such as the heights of a group of children on one particular day, is often grouped into categories to make it easier to interpret.

Activity 1: Presenting discrete and continuous data

Match the best choice of graph for the data below.

1. Chart to show a company's profit over a number of years.
2. Chart to show favourite drink chosen by customers in a shopping centre.
3. Chart to show the temperature on each day of the week.
4. Chart to show percentage of each sale of ticket type at a concert.

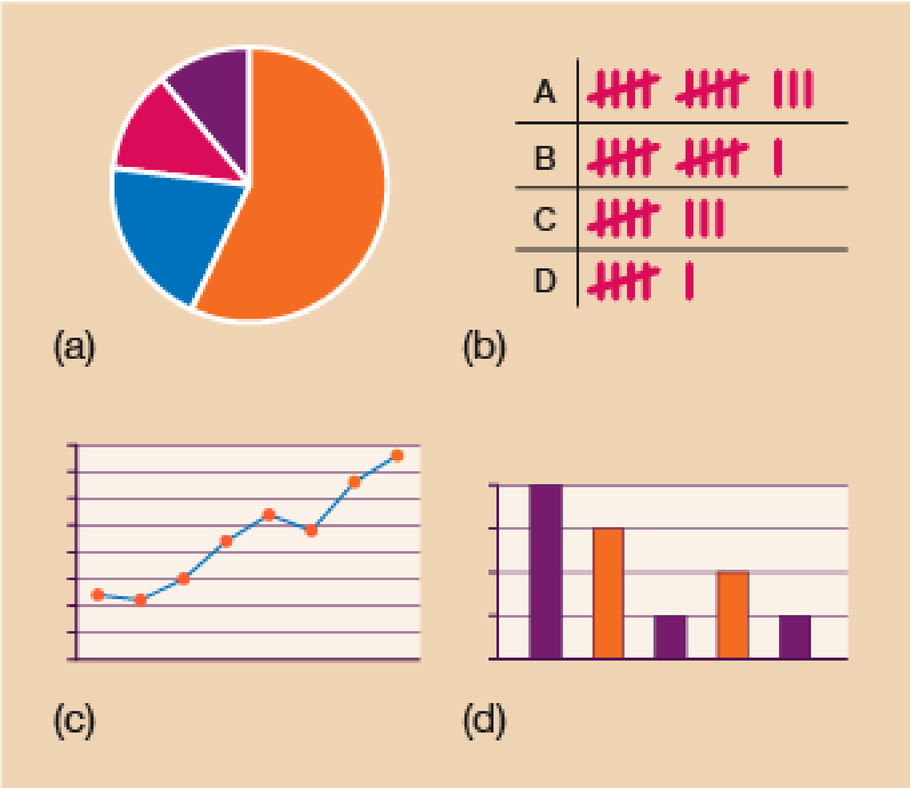


Figure 1 Different types of charts and graphs

Answer

1. Chart to show a company's profit over a number of years.

   The best choice here is **(d)** the bar chart as it can show the profit clearly year by year.
2. Chart to show favourite drink chosen by customers in a shopping centre.

   The best choice here is **(b)** the tally chart since you can add to this data as each customer makes their choice. A bar or pie chart would also be suitable.
3. Chart to show the temperature on each day of the week.

   The only choice here is **(c)** the line graph as it shows how the temperature changes over time.
4. Chart to show percentage of each sale of ticket type at a concert.

   The best choice here is probably **(a)** the pie chart since it shows clearly the breakdown of each type of ticket sale. A bar chart would also represent the data suitably.

Now that you are familiar with the two different types of data let's look in more detail at the different types of chart and graph; how to draw them accurately and how to interpret them.

Summary

In this section you have:

- learned about the two different types of data, discrete and continuous, and when and why they are used.

2 Tally charts, frequency tables and data collection sheets

Have you ever been stopped in the street or whilst out shopping and asked about your choice of mobile phone company or to sample some food or drink and give your preference on which is your favourite? If you have, chances are, the person who was conducting the survey was using a tally chart to collect the data.

Figure 2 Favourite fruit tally chart

Tally charts are convenient for this type of survey because you can note down the data as you go. Once all the data has been collected it can be counted up easily because, as shown in the picture above, every fifth piece of data for a choice is marked as a diagonal line. This allows you to count up quickly in fives to get the total. A frequency or total column can then be filled out to make the data easier to work with.

Take a look at the example below:

Table 1

Method of Travel	Tally	Frequency
Walk	卌 IIII	9

<table>
<tr><td>Bike</td><td>|||</td><td>3</td></tr>
<tr><td>Car</td><td>卌 |</td><td>6</td></tr>
<tr><td>Bus</td><td>卌 卌 ||</td><td>12</td></tr>
<tr><td></td><td>TOTAL</td><td>30</td></tr>
</table>

You can see each category and its total clearly. Whilst this is a very simple example it demonstrates the purpose of a tally chart well. A tally chart may often be turned into a bar chart for a more visual representation of the data but they are useful for the actual data collection.

You can also use a tally chart for collecting grouped data. If for example, you want to survey the ages of clients or customers, you would not ask for each person's individual age, you would ask them to record which age group they came within. If you want to set yourself up a tally chart for this data it might look similar to the below:

Table 2

Age	Tally	Frequency
0–9		
10–19		
20–29		
30–39		
40–49		
50–59		
60–69		
70+		

Note that the age groups do not overlap; a common mistake would be to make the groups 0–10, 10–20 and so on. This is incorrect because if you were aged 10, you would not know which group you should place yourself in.

A more complex example of a tally chart can be seen below. In this example you can see that the information that has been collected is split into more than one category. These are sometimes called data summary sheets or data collection tables. It doesn't matter where each category is placed on the chart as long as all aspects are included.

Table 3

	fewer than 6 trips		6 trips or more	
	under 26 years	26 years and over	under 26 years	26 years and over

male	I (1)	(0)	III (3)	~~IIII~~ I (6)
female	III (3)	(0)	I (1)	IIII (4)

If you want to design a data collection or data summary sheet, you first need to know which categories of information you are looking for. Let's take a look at an example of how you might do this.

Imagine you work in a hotel and want to gather some data on your guests. You want to know the following information:

- rating given by the guest: excellent, good, or poor
- length of stay: under 5 days, or 5 days or more
- location: from the UK, or from abroad.

A data summary sheet for this information could look like this:

Table 4

	Stayed for under 5 days			**Stayed for 5 days or more**		
	Excellent	Good	Poor	Excellent	Good	Poor
From the UK						
From abroad						

Have a go at the activity below and try creating a data collection sheet for yourself.

Activity 2: Data collection

You work at a community centre and want to gather some data on the people who use your services. You would like to know the following information:

- whether they are male or female
- if they use the centre during the day or during the evening
- which age category they are in: 0–25, 26–50, 51+.

Design a suitable data collection sheet to gather the information.

Answer

Your chart should look something like the example below. You may have chosen to put the categories in different rows and columns, which is perfectly fine. As long as all the options are covered your data collection sheet will be correct.

Table 5

	Daytime Visitor			**Evening Visitor**		
	0–25	26–50	51+	0–25	26–50	51+
Male						
Female						

Now that you know the different ways in which you can collect your data, it's time to look at how you can put this information into various charts and graphs.

Summary

In this section you have:

- explored the differences between tally charts, frequency tables and data collection sheets and understood their usefulness in data collection.

3 Bar charts

There are two main types of bar charts – single and dual. You can see examples of both below. Whilst both charts show the favourite sports of a group of students, the chart on the right-hand side breaks the data down into boys and girls; there are two bars for each sport. Depending on the type of data you are collecting, you could have more than two bars under each category.

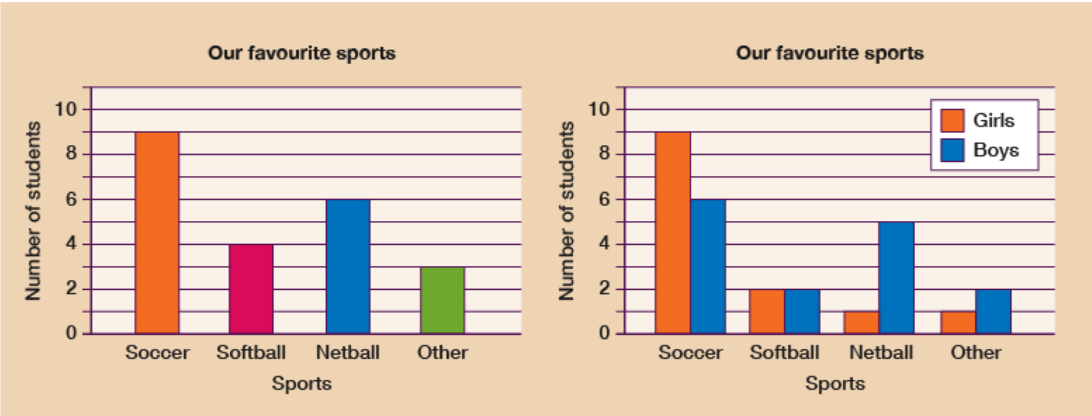


Figure 3 Single and dual bar charts

3.1 Features of a bar chart

Regardless of which type of bar chart you are drawing, there are certain features that all charts should have. Look at the diagram below to learn what they are.

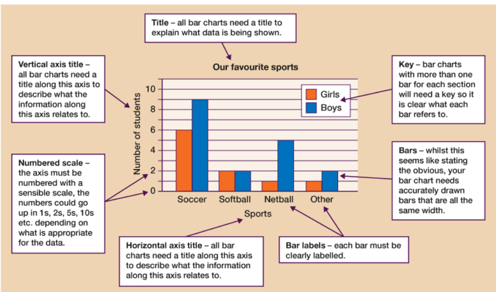


Figure 4 Features of a bar chart

Activity 3: Drawing a bar chart

Draw a bar chart to represent the information shown in the table below.

Table 6

	Leisure centre users			
	January	**February**	**March**	**April**
Male	175	154	120	165
Female	205	178	135	148

Answer

Your bar chart should look something like the example below. You may have chosen to use a different scale but your chart should have the following features:

- a title
- labels on both the horizontal and vertical axes
- bars labelled with the month
- accurately drawn bars of the same width
- a numbered scale on the vertical axis
- a key to show which bars are for males and which are for females.

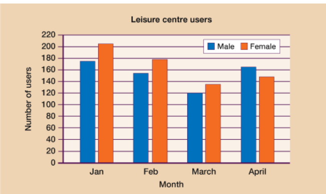


Figure 5 A bar chart showing numbers of leisure centre users

Now that you understand the features of bar charts and are able to draw them, let's look at how to interpret the information they show.

3.2 Interpreting bar charts

If you see a bar chart that is showing you information, it's useful to know how to interpret the information given. The most important thing you need to read to understand a bar chart correctly is the scale on the vertical axis.

As you know from drawing bar charts yourself, the numbers on the vertical axis can go up in steps of any size. You therefore need to work out what each of the smaller divisions is worth before you can use the information. The best way for you to learn is to practise looking at, and reading from, different bar charts.

Have a go at the activity below and see how you get on.

Activity 4: Interpreting bar charts

1. Shannon asked some students how they travelled to school. She drew this bar chart to show the results.

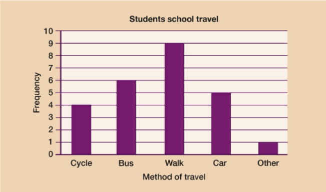


Figure 6 Bar chart of how students travel to school

a.

Which method of travel was used most by the students?

b.

How many more students walked to school than cycled to school?

c.

How many students did Shannon ask in total?

Answer

1.

a.

Walking was the most used method of travel

b.

Students who walked = 9. Students who cycled = 4.To find out how many more you do 9 – 4 = 5 more students walked than cycled.

c.

To work out the total number of students asked you need to add the amount shown by each bar together:

4 + 6 + 9 + 5 + 1 = 25 students in total.

---

2. The bar chart shows the number of adults and the number of children going to a museum each month from January to April.

Figure 7 Bar chart of museum visits

b.

How many adults went to the museum in March?

c.

How many more children than adults went to the museum in the 4 months from January to April?

Answer

2.

b.

The key shows that adults are represented by the white bar. In March, 300 adults went to the museum.

c.

To find out how many more children than adults went, you need to add up the total for the adults and the total for the children and then find the difference. The scale on the side goes up in 100s therefore the middle of each is 50. Adults: 500 + 650 + 300 + 600 = 2050Children: 600 + 500 + 750 + 300 = 2150Difference: 2150 – 2050 = 100 more children went than adults.

---

3. 90 cat owners were asked to write down the brand of cat food their cats liked best.

   The bar chart shows information about the results.

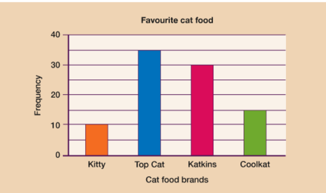


Figure 8 Bar chart of favourite brands of cat food

This statement was in the magazine:

1 out of 6 cats like Coolkat best

Is this statement correct? Explain your answer.

Answer

3. You need to know both the total that liked Coolkat and the total number of cats. The scale goes up in 10s so halfway between each numbered division is worth 5.

   The total who liked Coolkat is 15.

   In the question it tells you that 90 cat owners were surveyed so therefore 15 out of 90 liked Coolkat best.

   Simplifying this fraction:

   = =

   Yes, the statement is correct.

You should now be feeling confident with both drawing and interpreting bar charts so it's time to move on to look at another type of chart – pie charts.

Summary

In this section you have learned:

- to interpret the information shown on a bar chart
- about single and dual bar charts and practised using them to represent data.

4 Pie charts

Pie charts are a really good way of showing information that you want to be able to compare at a glance. It is very easy to visually see the largest and smallest sections of the chart and how they compare to the other sections.

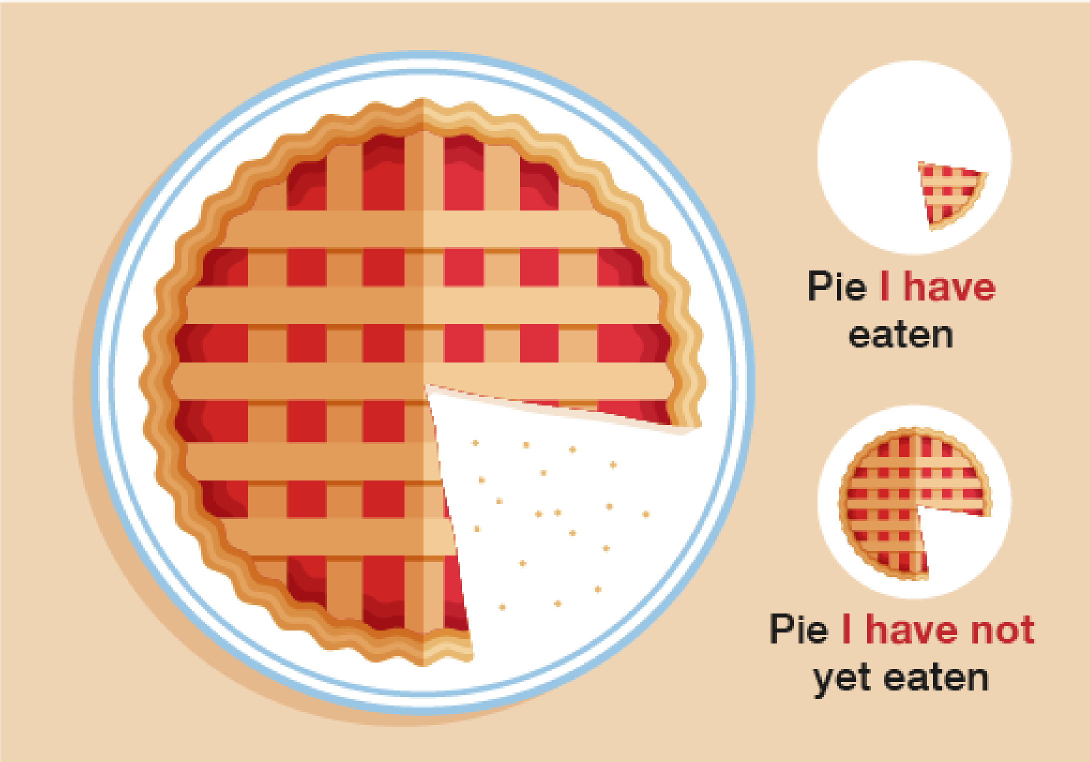


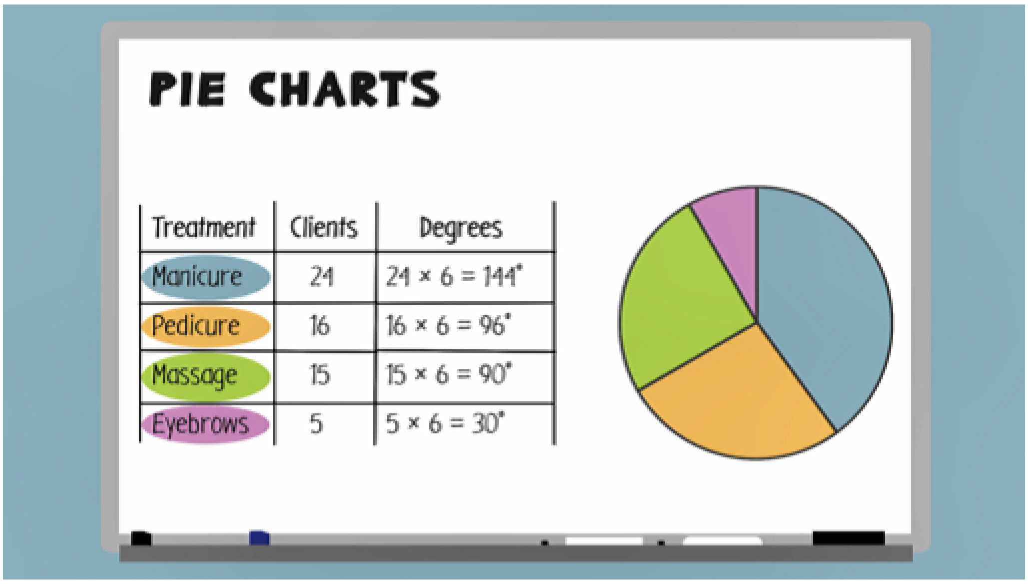
Figure 9 A partially eaten pie

In the first part of this section you'll learn how to draw and then move on to interpreting pie charts.

4.1 Drawing pie charts

The best way to understand the steps involved in drawing a pie chart is to watch the worked example in the video below.

Video content is not available in this format.



Now have a go at drawing a pie chart for yourself.

Activity 5: Drawing a pie chart

A leisure centre wants to compare which activities customers choose to do when they visit the centre. The information is shown in the table below. Draw an accurate pie chart to show this information.

Table 7

Activity	Number of customers
Swimming	26
Gym	17
Exercise class	20
Sauna	9

Answer

Firstly, work out the total number of customers: 26 + 17 + 20 + 9 = 72.

Now work out the number of degrees that represents customer: 360˚ ÷ 72 = 5˚ per customer.

Table 8

Activity	Number of customers	Number of degrees
Swimming	26	26 × 5 = 130˚
Gym	17	17 × 5 = 85˚
Exercise class	20	20 × 5 = 100˚
Sauna	9	9 × 5 = 45˚

Now use this information to draw your pie chart. It should look something like this:

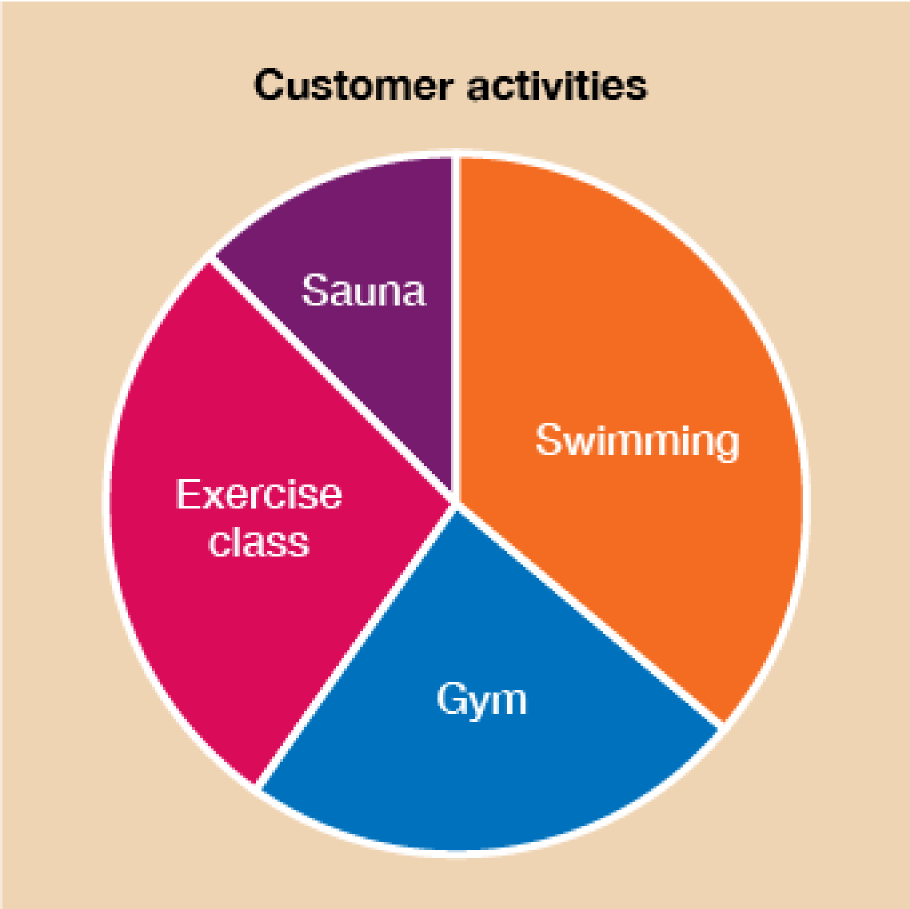


Figure 10 Pie chart for customer leisure centre activities

Now that you can accurately draw a pie chart, it's time to look at how to interpret them. You won't always be given the actual data, you may just be given the total number represented by the chart or a section of the chart and the angles on the pie chart itself. It's useful to know how to use your maths skills to work out the actual figures.

Here's a reminder of the degrees of a circle which will be useful when you come to read from pie charts.

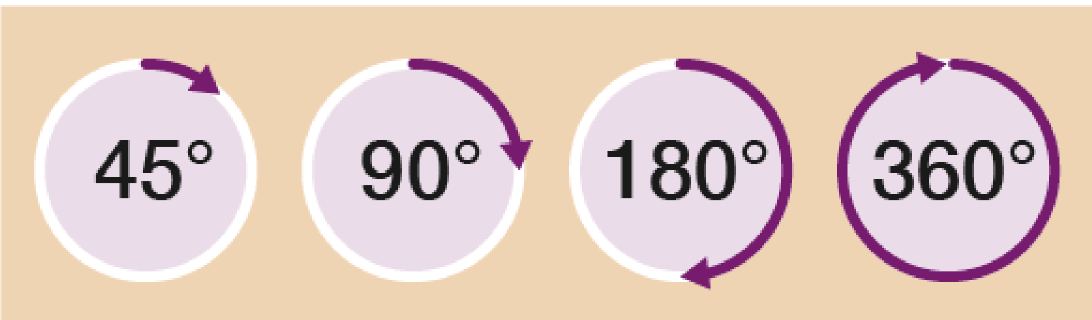


Figure 11 Degrees of a circle

4.2 Interpreting pie charts

Imagine you've been presented with the pie chart below. The chart shows the ages of students competing at an athletic event.

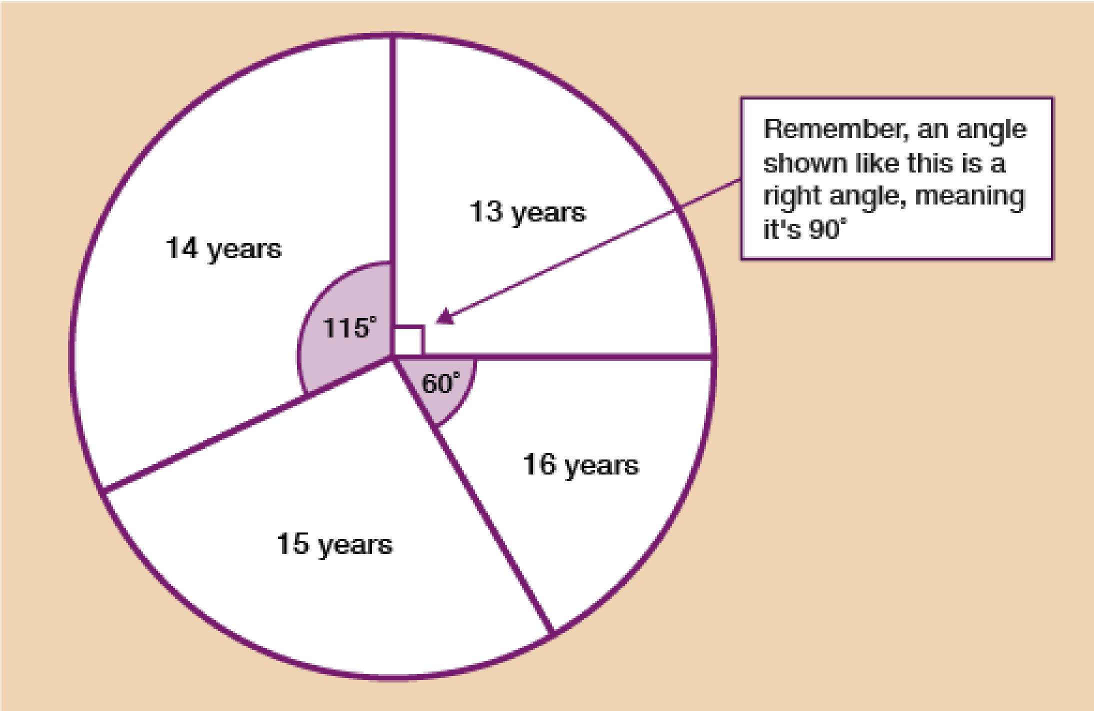


Figure 12 Interpreting pie charts

There are two possible pieces of information you could be given. You could be given the total number of students that were at the event, or, you could be given the number of students in one of the age categories.

Example: Reading a pie chart 1

Let's say you were told that 72 people attended the competition. Since you know that 360˚ has been shared equally between all 72 people, you do 360 ÷ 72 = 5˚ per person.

Once you know this, if you wanted, for example, to know how many students that took part were 16 years old, you would look at the degrees on the chart for 16-year-old's which in this example is 60˚.

You would do 60 ÷ 5 = 12 students.

If you wanted to work out the number of 15-year-olds, you would first need to work out the missing angle; you know that all the angles will add up to 360˚ so just do:

360 – 115 – 90 – 60 = 95˚

And now do the same as before 95 ÷ 5 = 19 students who were 15 years old.

Example: Reading a pie chart 2

Using the same pie chart, let’s say that all you were told was that 23 students took part who were 14 years old.

You can see that the angle for 14-year-olds is 115˚ and you’ve been told that this represents 23 students.

To find out how many degrees each student gets, you do 115 ÷ 23 = 5˚ per student.

Once you know this you can find out how many students are represented by each other section in the same way as we did in example 1. For example, the 13-year-olds have an angle of 90˚.

To find out how many there are you do 90 ÷ 5 = 18 students who were 13 years old.

Pie charts are very similar to ratio. In ratio questions you are always looking to find out how much 1 part is worth, in pie chart questions, you are looking to find how many degrees represents 1 person (or whatever object the pie chart is representing).

As well as being closely linked with ratio, pie charts also involve the use of your fractions skills. If, for example, you were asked what fraction of the students were 16 years old, you can show this as since the 16-year-olds are 60 degrees out of the total 360 degrees.

Using your fractions skills however, the fraction can be simplified to

It’s time for you to practise your skills at interpreting pie charts. Have a go at the activity below and then check your answers with the feedback given.

Activity 6: Interpreting pie charts

1. The pie chart below shows how long a gardener spent doing various activities over a month.

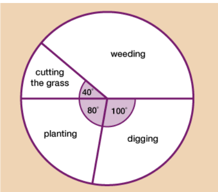


Figure 13 Pie chart of gardening activities

a.

What fraction of the time was spent planting? Give your answer in its simplest form.

b.

5 hours were spent digging. How long was spent on cutting the grass?

Answer

1.

a.

Planting = = in its simplest form.

b.

Digging is 100˚ and you know that that was 5 hours. 100˚ ÷ 5 = 20˚ for each hour.Since cutting the grass has an angle of 40˚, you do 40 ÷ 20 = 2 hours cutting the grass.

---

2. 120 adults participating in an online course were asked if they felt there were enough activities for them to complete throughout the course. The pie chart below shows the results.

Figure 14 Pie chart of opinions about an online course

b.

What fraction of the adults thought there were too many activities? Give your answer in its simplest form.

c.

How many adults thought there were enough activities?

Answer

2.

b.

Too much = = in its simplest form.

c.

You know that 120 adults took part in the survey. To find out how many degrees represents each adult, you do 360 ÷ 120 = 3 degrees per person. Next you need to know the angle for those who said there were enough activities. For this, you do: 360 – 105 – 60 – 45 = 150˚Now you know this, you can do: 150 ÷ 3 = 50 adults thought there were enough activities.

Well done! You can now draw and interpret bar charts and pie charts; both of which are good ways to represent discrete data. In the next part of this session, you will learn how to draw and interpret line graphs.

Summary

In this section you have learned:

- what types of information can be represented effectively on a pie chart
- how to use and interpret a pie chart
- how to draw an accurate pie chart when given a set of data.

5 Line graphs

Line graphs are a very useful way to spot patterns or trends over time. The example below shows the population over a number of years of a rare type of bird on a small island. Just from looking at the graph we can see that the population of birds is going down over time, with a brief period between 2006 and 2007 where there was a slight rise.

If you were looking at how to increase the numbers of these birds, you would look more closely at what happened over those years and see what circumstances might have helped the population grow. Once you had discovered this, you could try to replicate it over coming years to try and increase the population.

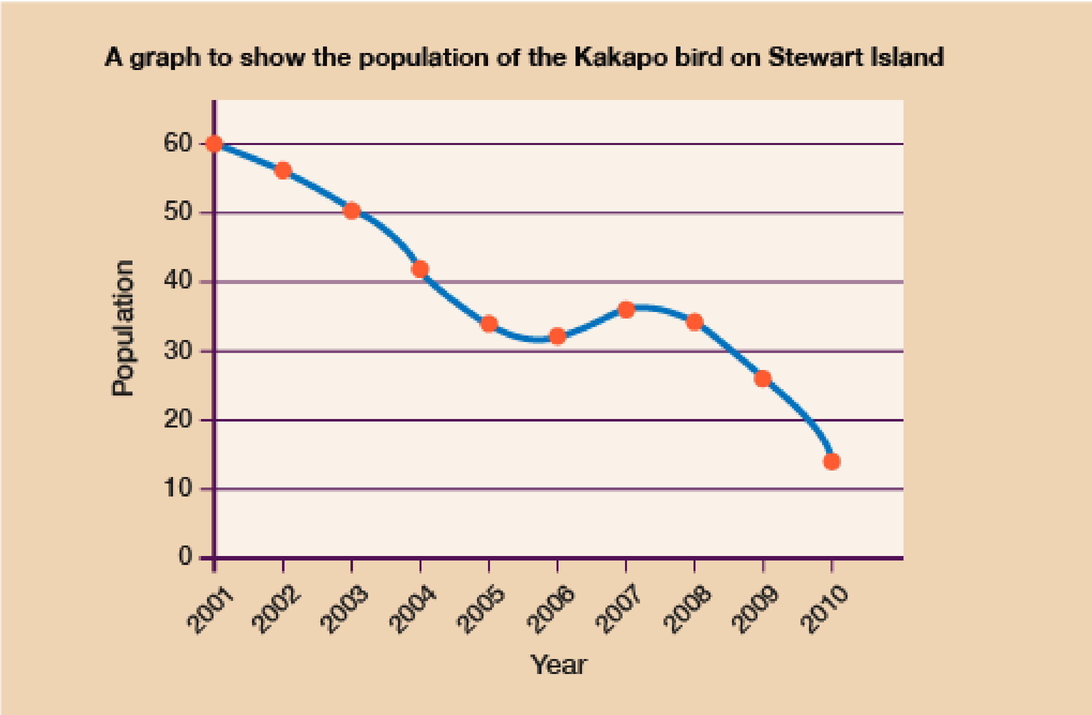


Figure 15 A graph to show the population of the Kakapo bird on Stewart Island

Now that you understand how useful line graphs can be and how they can be used, next you'll learn how to draw and interpret them.

5.1 Drawing line graphs

Drawing a line graph is very similar to drawing a bar chart, and they have many of the same features.

Line graphs need:

- a title
- a title for each axis
- a numbered scale on the vertical axis
- labels on the horizontal axis (in the example in Figure 15; 2001, 2002 etc.) so that it is clear to the reader what they are looking at.

The main difference when drawing a line graph rather than a bar chart, is that rather than a bar, you put a dot or a small cross to represent each piece of information. You then join each dot together with a line. There is significant debate over whether the dots should be joined with a curve (as in the example in Figure 15) or with straight line. Whilst the issue is (believe it or not!) hotly contested, the general consensus seems to be that dots should be joined with straight lines.

Activity 7: Drawing a line graph

Have a go a drawing a line graph to represent the data below.

The table below shows the temperature in London on one day in October.

Table 9

Time	7 am	9 am	11 am	1 pm	3 pm	5 pm	7 pm
Temperature (˚C)	7˚	8˚	12˚	13˚	11˚	10˚	6˚

Answer

Your graph should look similar to the one shown below.

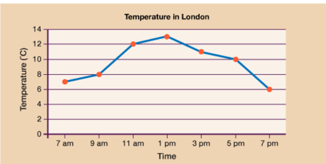


Figure 16 A line graph of temperature and time

5.2 Interpreting line graphs

Interpreting line graphs is also very similar to the way you interpret bar charts; it's just about using the scales shown on the graph to find out information. Given that you've already learned and practised interpreting bar charts, you can jump straight into an activity on interpreting line graphs.

Activity 8: A population line graph

1. The graph shows information about the population of a village in thousands.

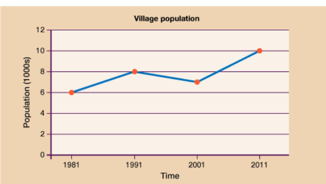


Figure 17 Line graph showing village population over time

a.

What was the population of the village in 1991?

b.

What was the increase in population from 1981 to 2011?

Answer

1.

a.

In 1991 the population was 8000.

b.

In 1981 the population was 6000, in 2011 the population was 10,000. This is an increase of 10,000 − 6000 = 4000.

---

2. Beth recorded the temperature, in degrees (°C), inside her greenhouse every hour on one day.

The graph shows information about her results.

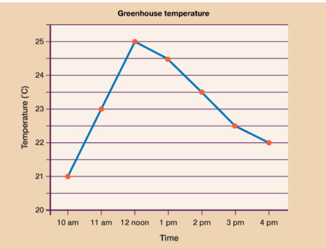


Figure 18 Line graph showing greenhouse temperature over time

b.

What was the temperature at 3 pm?

c.

Describe the change in temperature from 12 noon to 4 pm.

d.

For how many hours was the temperature in the green house above 23˚C.

Answer

2.

b.

At 3 pm the temperature was 22.5˚C.

c.

From 12 noon to 4 pm the temperature is dropping. It drops from its highest at 25˚C to 22˚C at 4 pm.

d.

The temperature hit 23˚C at 11 am and remained at or above this temperature until 2:30 pm.This is a period of 3 and a half hours.

How did you get on? Hopefully you were able to answer all the questions without too much difficulty. As long as you have worked out the scale correctly and read the question carefully, there's nothing too tricky involved.

You have now covered each drawing and interpreted each different type of chart and graph so it's time to move on to look at other uses for data: averages and range.

Summary

In this section you have learned:

- which types of data can be suitably represented by a line graph and which are best suited to other types of charts.
- how to interpret the information shown on a line graph
- how to draw an accurate line graph for a given set of data.

6 Averages: range, mean and median

The three types of averages that you will be focussing on in this part of the session are range, mean and median. There is one other type of average, called the mode, but this course requires you only to be familiar with the three you are about to cover.

6.1 Range

Figure 19 A mountain range of different sized peaks

Much like this stunning mountain range is made up of a variety of different sized mountains, a set of numerical data will include a range of values from smallest to biggest. The range is simply the difference between the biggest value and the smallest value. The range can be useful to know because data sets with a big difference between the highest and lowest values can imply a certain amount of risk.

Let's say there are two basketball players and you are trying to choose which player to put on for the last quarter. If one player has a large range of points scored per game (sometimes they score a lot of points but other times they score very few) and the other player has a smaller range (meaning they are more consistent with their point scoring) it might be safest to choose the more consistent player.

Take a look at the example below.

A farmer takes down information about the weight, in kg, of apples that one worker collected each day on his farm.

Table 10

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
56 kg	70 kg	45 kg	82 kg	67 kg	44 kg	72 kg

In order to find the range of this data, you simply find the biggest value (82 kg) and the smallest value (44 kg) and find the difference:

$$82 - 44 = 38 \text{ kg}$$

The range is therefore 38 kg.

Now let's compare this worker to another worker whose information is shown in the table below.

Table 11

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
56 kg	60 kg	58 kg	62 kg	65 kg	49 kg	58 kg

This worker has a highest value of 65 kg and a lowest value of 49 kg. The range for this worker is therefore 65 – 49 = 16 kg. The second worker is therefore a more consistent apple picker than the first worker.

Now try one for yourself.

Activity 9: Finding the range

1. The table below shows the sales made by a café on each day of the week:

Table 12

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
£156.72	£230.54	£203.87	£179.43	£188.41	£254.70	£221.75

   What is the range of sales for the café over the week?

2. A bowling team want to compare the scores for their players. The table below shows their results.

Table 13

Name	Andy	Bilal	Caz	Dom	Ede
Highest score	176	175	162	170	150
Lowest score	148	145	142	165	116

   Which player is the most consistent? Give a reason for your answer.

Answer

1. Simply find the highest value: £254.70, and lowest value: £156.72, then find the difference:

   £254.70 − £156.72 = £97.98

2. You need to look at the range for each player:

   Andy: 176 − 148 = 28

   Bilal: 175 − 145 = 30

   Caz: 162 − 142 = 20

   Dom: 170 − 165 = 5

   Ede: 150 − 116 = 34

   The player with the smallest range is Dom and so Dom is the most consistent player.

As you have seen, finding the range of a set of data is very simple but it can give some useful insights into the data. The most commonly used average is the ‘mean average’ (or sometimes just the mean) and you’ll look at this next.

6.2 Mean average

There are three things that you will learn about in this section:

- finding the mean when given a set of data
- finding the mean from a frequency table
- finding missing data when given the mean.

Figure 20 Below average and mean average

The mean is a good method to use when you want to compare a large set of data, for example:

- the average amount spent by customers in a shop
- the average cost of a house in a certain area
- the average time taken for your chosen breakdown service to get to your car.

The mean average can help us make comparisons between sets of data which can then help you when making a decision.

6.3 Finding the mean from a set of data

To find the mean of a simple set of data, all you need to do is find the total, or sum, of all the items together and then divide this total by how many items of data there are.

Table 11 (repeated)

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
56 kg	60 kg	58 kg	62 kg	65 kg	49 kg	58 kg

Look again at the weight, in kg, of apples that one worker collected each day on an apple farm (shown above). If you want to calculate the mean average weight of apples collected, you first find the sum or total of the weight of apples collected in the week:

56 + 60 + 58 + 62 + 65 + 49 + 58 = 408 kg

Next, divide this total but the number of data items, in this case, 7:

408 ÷ 7 = 58.3 kg (rounded to one d.p.)

It is important to note that the mean may well be a decimal number even if the numbers you added together were whole numbers.

Another important thing to note here is that the two sums (the addition and then the division) are done as two separate sums. If you were to write:

56 + 60 + 58 + 62 + 65 + 49 + 58 ÷ 7

this would be incorrect (remember BIDMAS from Session 1?). Unless you are going to use brackets to show which sum needs to be done first (56 + 60 + 58 + 62 + 65 + 49 + 58) ÷ 7, it is accurate to write two separate calculations.

Have a go at calculating the mean for yourself by completing the activity below.

Activity 10: Finding the mean

1. The table below shows the sale price of ten, 2 bedroom semi-detached houses in a town in Liverpool.

Table 14

House 1	House 2	House 3	House 4	House 5	House 6	House 7	House 8	House 9	House 10
£70,000	£65,950	£66,500	£71,200	£68,000	£62,995	£70,500	£68,750	£59,950	67,900

What is the mean house price in this area?

2. The table below shows the units of gas used by a household for the first 6 months of a year.

Table 15

January	February	March	April	May	June
1650	1875	1548	1206	654	234

Calculate the mean amount of gas units used per month.

Answer

1. First find the total of the house prices:

   £ 70,000 + £ 65,950 + £ 66,500 + £ 71,200 + £ 68,000 + £ 62,995 + £ 70,500 + £ 68,750 + £ 59,950 + £ 67,900 = £ 671,745

   Now divide this total by the number of houses (10):

   £671,745 ÷ 10 = £67,174.50

2. Find the total number of units used:

   1650 + 1875 + 1548 + 1206 + 654 + 234 = 7167 units

   Now divide this total by the number of months (6):

   7167 ÷ 6 = 1194.5 units

This method of finding the mean is fine if you have a relatively small set of data. What about if the set of data you have is much larger? If this was the case, the data would probably not be presented as a list of numbers, it's much more likely to be presented in a frequency table.

In the next part of this section, you will learn how find the mean when data is presented in this way.

6.4 Finding the mean from a frequency table

Large groups of data will often be shown as a frequency table, rather than as a long list. This is a much more user friendly way to look at a large set of data. Look at the example below where there is data on how many times, over a year, customers used a gardening service.

Table 16

Number of visits in a year	Number of customers
1	6
2	10
3	11
4	16
5	4
6	3

We could write this as a list if we wanted to:

1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3 and so on

but it's much clearer to look at in the table format. But how would you find the mean of this data? Well, there were 6 customers who had one visit from the gardening company, that's a total of 1 × 6 = 6 visits. Then there were 10 customers who had 2 visits, that's a total of 2 × 10 = 20 visits. Do this for each row of the table, as shown below.

Table 17

Number of visits in a year	Number of customers	Total visits
1	6	1 × 6 = 6
2	10	2 × 10 = 20
3	11	3 × 11 = 33
4	16	4 × 16 = 64
5	4	5 × 4 = 20
6	3	6 × 3 = 18

	Total = 50 customers	Total = 161 visits

Finally, work out the totals for each column (highlighted in a lighter colour on the table above).

Now you have all the information you need to find the mean; the total number of visits is 161 and the total number of customers is 50 so you do 161 ÷ 50 = 3.22 visits per year as the mean average.

Warning! Many people trip up on these because they will find the total visits (161) but rather than divide by the total number of customers (50) they divide by the number of rows in the table (in this example, 6).

If you do 161 ÷ 6 = 26.83, logic tells you, that since the maximum number of visits any customer had was 6, the mean average cannot be 26.83. Always sense check your answer to make sure it is somewhere between the lowest and highest values of the table. For this example, anything below 1 or above 6 must be incorrect!

Have a go at a couple of these yourself so that you feel confident with this skill.

Activity 11: Finding the mean from frequency tables

1. The table below shows some data about the number of times children were absent from school over a term.

   Work out the mean average number of absences.

Table 18

Number of absences	Number of children
1	26
2	13
3	0
4	35
5	6

Answer

1. First, work out the total number of absences by multiplying the absence column by the number of children. Next, work out the totals for each column.

Table 19

Number of absences	Number of children	Total number of absences
1	26	1 × 26 = 26
2	13	2 × 13 = 26
3	0	3 × 0 = 0
4	35	4 × 35 = 140
5	6	5 × 6 = 30
	Total = 80	Total = 222

   To find the mean do: 222 ÷ 80 = 2.775 mean average.

2. You run a youth club for 16–21-year-olds and are interested in the average age of young people who attend.

   You collect the information shown in the table below. Work out the mean age of those who attend. Give your answer rounded to one decimal place.

Table 20

Age	Number of young people
16	3
17	8
18	5
19	12
20	6
21	1

Answer

2. Again, first work out the totals for each row and column.

Table 21

Age	Number of young people	Age × Number
16	3	16 × 3 = 48
17	8	17 × 8 = 136
18	5	18 × 5 = 90
19	12	19 × 12 = 228
20	6	20 × 6 = 120
21	1	21 × 1 = 21
	Total = 35	Total = 643

To find the mean you then do:

- 643 ÷ 35 = 18.4 years (rounded to one d.p.)

If you are given all the data in a set and asked to find the mean, it's a relatively simple process (as long as you have your calculator handy!). What if you are only given some of the data and the mean? How do you go about working out the missing data? The next part of this section deals with these kind of 'reverse mean' skills.

6.5 Calculating missing data when given the mean

Sometimes, rather than being given the data and asked to find the mean, you may be given some of the data as well as the mean and asked to find the missing piece of data.

Example: Finding the missing number 1

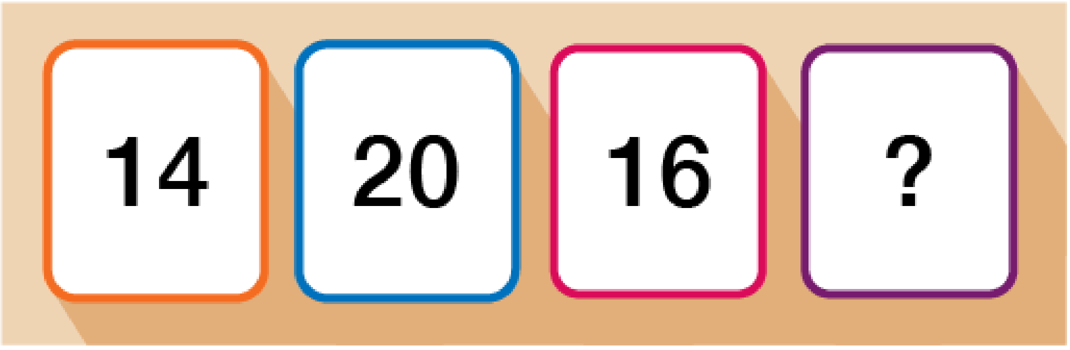


Figure 21 Calculating missing data using the mean

The mean of the numbers on 4 cards is 15. Find the missing number.

Method

If you think about how we work out the mean – add up all the numbers and then divide by how many numbers there are – for this example, the calculation looks like this:

= 15

If we ‘undo’ the division by 4, by multiplying both sides by 4 we are left with:

Total of numbers = 15 × 4

Total of numbers = 60

Now that you know the total of all 4 numbers is 60, to find the missing number you can simply subtract the numbers that you do know from 60.

60 – 14 – 20 – 16 = 10

The missing number is therefore 10.

Let’s take a look at a slightly different example.

Example: Finding the missing number 2

A rugby team has played a total of 12 matches over the season. The mean average number of points scored is 14. The team play one more match and score 20 points. How does this affect the mean average over the 13 games?

Method

Again, you know that for this example:

= 14

Similarly to the last example, if you 'undo' the division by 12 by multiplying both sides by 12, you are left with:

Total of numbers = 12 × 14

Total of numbers = 168

Now you know the total of points scored in the first 12 games played. You have been told in the question that the team play one more game and score 20 points. The new total for all 13 games is therefore 168 + 20 = 188 points.

To find the mean we now do, = 14.5 (rounded to one d.p.). Therefore, the mean average increases after the thirteenth game is played.

Now have a go at the activity below and check your knowledge and understanding.

Activity 12: Problem solving using the mean

1. The mean of all 5 cards is 31. Work out the missing number.

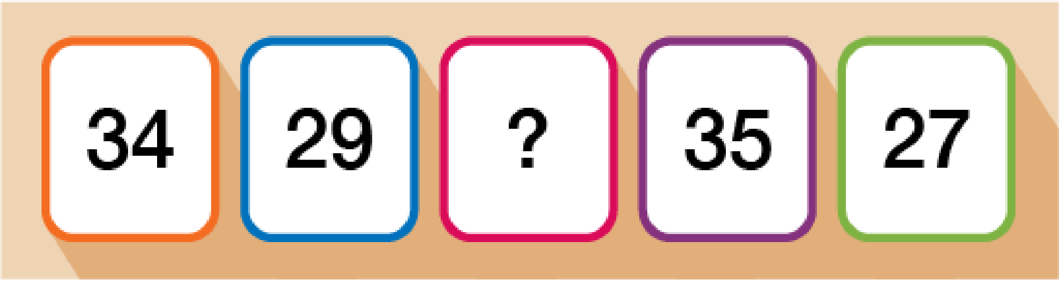


Figure 22 Problem solving using the mean

2. A shop works out the mean average sales over the first 6 months of the year. The mean for these 6 months is £2400. In the following month, the mean increases to £2500. How much did the shop make in the seventh month?

Answer

1. = 31

   Total of numbers = 31 × 5

   Total of numbers = 155

   Now you know the total of all 5 cards, do:

   155 – 34 – 29 – 35 – 27 = 30

   The missing number is 30.

2. For this question you first need to work out the total money made by the shop in the first 6 months:

= £2400Total of numbers = £2400 × 6

Total of numbers = £14,400

Now you know this, you can work out the total amount of money raised by the shop over the 7-month period:

= £2500Total of numbers = £2500 × 7Total of numbers = £17,500

To work out the amount raised in the seventh month, now do £17,500 − £14,400 = £3100 raised in the seventh month.

6.6 Median

The last type of average you will look at briefly is called the median. Put very simply, the median is the middle number in a set of data. The only thing you need to remember is to put the numbers in size order, smallest to largest, before you begin. As this is such a simple process let's just look at two examples.

Example: Finding the median 1

Find the median of this data set:

Method

5, 10, 8, 12, 4, 7, 10

Firstly, order the numbers from smallest to largest:

4, 5, 7, 8, 10, 10, 12

Now, find the number that is in the middle:

4, 5, 7, **8**, 10, 10, 12

8 is the number in the middle, so the median is 8.

Example: Finding the median 2

Find the median of this data set:

Method

24, 30, 28, 40, 35, 20, 49, 38

Again, you firstly need to order the numbers:

20, 24, 28, 30, 35, 38, 40, 49

And then find the one in the middle:

20, 24, 28, **30**, **35**, 38, 40, 49

In this example there are actually two numbers that are in the middle, you therefore find the middle of these two numbers by adding them together and then halving the answer:

(30 + 35) ÷ 2 = 32.5

The median for this set of data is 32.5.

If you want to see some more examples, or try some for yourself, use the link below:

https://www.mathsisfun.com/median.html

Well done! You have now learned all you need to know about mean, median and range. The final part of this section, before the end-of-session quiz, looks at probability.

Summary

In this section you have learned:

- that there are different types of averages that can be used when working with a set of data – range, mean, median and mode
- range is the difference between the largest data value and the smallest data value and is useful for comparing how consistently someone or something performs
- mean is what is commonly referred to when talking about the average of a data set
- how to find the mean from both a single data set and also a set of grouped data
- formulas and inverse operations to calculate missing data when given the mean of a data set
- what the median of a data set is and how to find it for a given set of data.

7 Probability

You will use probability regularly in your day-to-day life:

- Should you take an umbrella out with you today?
- What are the chances of the bus being on time?
- How likely are you to meet your deadline?

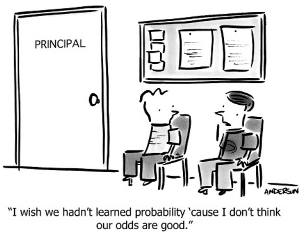


Figure 23 Probability – the odds are you are already using it

Probability is all about how likely, or unlikely, something is to happen. When you flip a coin for example, the chances of it landing on heads is ½ or 50% or 0.5 – remember from your work in Session 1 how fractions, decimals and percentages can be converted into one another?

The probability, or likelihood, of an event happening is perhaps most easily expressed as a fraction to begin with. Then, if you want to express it as a percentage or a decimal you can just convert it.

Let's look at an example.

Example: Chocolate probability

A box of chocolates contains 15 milk chocolates, 5 dark chocolates and 10 white chocolates. If the box is full and you choose a chocolate at random, what is the likelihood of choosing a dark chocolate?

Method

There are 5 dark chocolates in the box. There are 15 + 5 + 10 = 30 chocolates in the box altogether.

The probability of choosing a dark chocolate is therefore:

=

You could also be asked the probability of choosing either a dark or a white chocolate. For this you just need the total of dark and white chocolates:

5 + 10 = 15

The total number of chocolates in the box remains the same so the likelihood of choosing a dark or a white chocolate is:

=

You could even be asked what the likelihood is of an event not happening. For example, the likelihood that you will not choose a white chocolate. In this case, the total number of chocolates that are not white is 15 + 5 = 20.

Again, the total number of chocolates in the box remains the same and so the probability of not choosing a white chocolate is:

=

Now have a go yourself by completing the short activity below.

Activity 13: Calculating probability

1. You buy a packet of multi-coloured balloons for a children's party. You find that there are 26 red balloons, 34 green balloons, 32 yellow balloons and 28 blue balloons.

   You take a balloon out of the packet without looking. What is the likelihood of choosing a green balloon?

   Give your answer as a fraction in its simplest form.
2. At the village fete, 350 raffle tickets are sold. There are 20 winning tickets. What is the probability that you will not win the raffle?

   Give your answer as a percentage rounded to two decimal places.

Answer

1. There are 34 green balloons. The total number of balloons is 26 + 34 + 32 + 28 = 120.

   The likelihood of choosing a green balloon is therefore:

   = in its simplest form.
2. If there are 20 tickets that are winning ones, there are 350 − 20 = 330 tickets that will not win a prize.

   As a fraction this is:

   To convert to a percentage, you do 330 ÷ 350 × 100 = 94.29% rounded to two d.p.

You've now completed Session 3 of your course, congratulations! Before you begin the fourth and final session, try the end-of-session quiz to check your skills.

Remember that when you are checking your answers, you may have gone about the question in a different way. In a real exam it is always important to show your working as even if you don't arrive at the correct answer you can still gain marks.

Summary

In this section you have learned:

- that the probability of an event is how likely or unlikely that event is to happen and that this can be expressed as a fraction, decimal or percentage.

8 Session 3 quiz

Now it's time to review your learning in the end-of-session quiz.

Session 3 quiz.

Open the quiz in a new window or tab (by holding ctrl [or cmd on a Mac] when you click the link), then return here when you have done it.

9 Session 3 summary

You have now completed Session 3, 'Handling data'. If you have identified any areas that you need to work on, please ensure you refer back to this section of the course.

You should now be able to:

- identify the two different types of data and where they are used
- create and use tally charts, frequency tables and data collection sheets to record information
- draw and interpret bar charts, pie charts and line graphs
- understand that there are different types of averages and be able to calculate each type
- understand that probability is about how likely an event is to happen and the different ways that it can be expressed.

All of the skills listed above will help you when booking a holiday, budgeting, reading the news or analysing data at work.

You are now ready to move on to Session 4, 'Shape and space'.

Session 4: Shape and space

Introduction

Take a look at the picture below. In order to decorate the room, you would need know the length of skirting required (perimeter), how much carpet to order and how many tins of paint to buy (area). You would also need to use your rounding skills (as items such as paint and skirting must be bought in full units) and your addition and multiplication knowledge – to work out the cost!

Figure 1 Floor plan of a house

This session of the course will draw upon the skills you learned in the 'Working with numbers' and 'Units of measure' sessions.

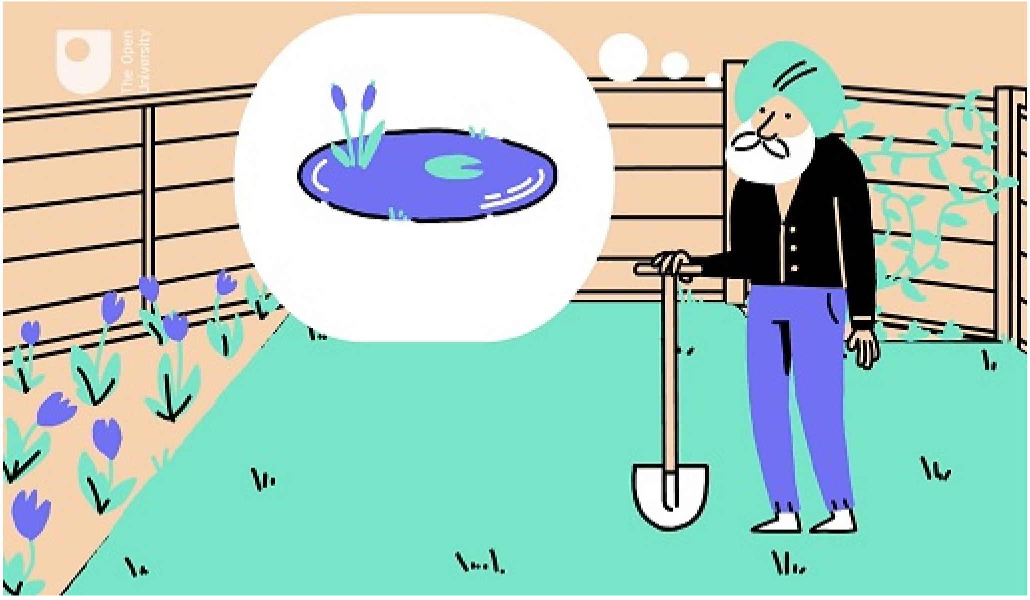
Throughout this session you will learn how to find the perimeter, area and volume of simple and more complex shapes – if you've ever decorated a room you will be familiar with these skills already. It's important to be able to work out area and perimeter accurately to ensure you buy enough of each material (but not too much to avoid wastage).

Once your room is beautifully decorated, you're going to need to plan the best layout for your furniture (and make sure it fits!). You may well use a scale drawing to achieve this.

By the end of this session you will be able to:

- understand the difference between perimeter, area and volume and be able to calculate these for both simple and more complex shapes
- know that volume is a measure of space inside a 3D object and calculate volumes of shapes in order to solve practical problems
- draw and use a scale drawing or plan.

Video content is not available in this format.



1 Perimeter

As you will see from the picture below, perimeter is simply the distance around the outside of a shape or space. The space you need to find the perimeter of could be anything from working out how much fencing you need to go around the outside of your garden to how much ribbon you need to go around the outside of a cake. Shapes or spaces with straight edges (rather than curved) are easiest to calculate so let's begin by looking at these.

Figure 2 A perimeter fence

1.1 Perimeter of simple shapes

Figure 3 Finding the perimeter of simple shapes

In order to work out the perimeter of the shapes above, all you need to do is simply add up the total length of each of the sides.

- Rectangle: 10 + 10 + 6 + 6 = 32 cm.
- Triangle: 12 + 12 + 17 = 41 cm.
- Trapezium: 10 + 12 + 10 + 18 = 50 cm.

When you give your answer, make sure you write the units in cm, m, km etc. One other important thing to note is that before you work out the perimeter of any shape, you must make sure all the measurements are given in the same units. If, for example, two lengths are given in cm and one is given in mm, you must convert them all to the same unit before you work out the total. It doesn't usually matter which measurement you choose to convert but it's wise to check the question first because sometimes you might be asked to give your answer in a specific unit.

Activity 1: Finding the perimeter

Work out the perimeters of each of the shapes below.

Remember to give units in your answer and to check that all measurements are in the same units before you begin to add.

1.

Figure 4 Calculating the perimeter – Question 1

2.

Figure 5 Calculating the perimeter – Question 2

3.

Figure 6 Calculating the perimeter – Question 3

Answer

1. 24 + 18 + 24 + 18 = 84 m.
2. If you worked in cm:

    1.2 m = 120 cm. Therefore, the perimeter is 120 + 120 + 90 = 330 cm.

   If you worked in m:

    90 cm = 0.9 m.Therefore, the perimeter is 0.9 + 1.2 + 1.2 = 3.3 m.
3. 50 mm = 5 cm, 62 mm = 6.2 cm.

   Therefore, the perimeter is 24 + 5 + 10 + 6 + 6.2 + 20 = 71.2 cm.

Hopefully, you found working out the perimeters of these shapes fairly straightforward.

The next step on from shapes like the ones you have just worked with, is finding the perimeter of shapes where not all the lengths are given to you. In shapes such as a rectangle or regular shapes like squares (where all sides are the same length) this is a simple process. However, in a shape where the sides are not the same as each other, you have a little more work to do.

1.2 Perimeters of shapes with missing lengths

Figure 7 Finding the perimeter when measurements are missing

Look at the shape above. You can see that one of the lengths is missing from the shape. How do you find the perimeter when you don’t have all the measurements? You cannot just assume that missing length (yellow) is half of the red length, so how do you work it out? You’ll need to use the information that is given in the rest of the shape.

If you look at all the vertical lengths (red, yellow and green) you can see that we know the length of two of the three. You can also see that green + yellow = red, since the two shorter lengths put together would equal the same as the longest vertical length.

If 17 + ? = 30, then in order to find the missing length you must do 30 − 17 = 13.

The missing length is therefore 13 m. Now that you know this, you can work out the perimeter of the shape in the normal way.

Let’s look at one more example before you try some on your own.

Figure 8 Finding the perimeter when a length is missing

In the example above, you will see that there is again a missing length. This time the missing length (yellow) is a horizontal one and so you need to look at the other two horizontal lengths (red and green) in order to work out the missing side.

You can see that this time that red + green = yellow, since the missing length is the sum of the two shorter lengths. You can now do 9 + 28 = 37, so the missing length is 37 m.

Now that you know all the side lengths, you can work out the perimeter by finding the total of all the lengths.

Activity 2: Perimeters and missing lengths

1. Work out the perimeter of the shape below.

Figure 9 Perimeters and missing lengths – Question 1

2. You are redecorating your living room and need to replace the skirting board. The layout of the room is shown below. Skirting board can only be bought in lengths of 2 m.

   How many lengths should you buy?

Figure 10 Perimeters and missing lengths – Question 2

Answer

1. Firstly, you need to work out the missing length:

   15 + 27 = 42 m

   So the perimeter is:

   42 + 12 + 27 + 16 + 15 + 28 = 140 m
2. Again, work out the missing length first:

   4.5 − 2.2 = 2.3 m

   Next, work out the perimeter of the room:

   2.5 + 2.2 + 2.7 + 2.3 + 5.2 + 4.5 = 19.4 m

   To see how many 2 m length of skirting you will need do 19.4 ÷ 2 = 9.7.

   Since we can only buy whole lengths we need to round this up to 10 lengths of skirting.

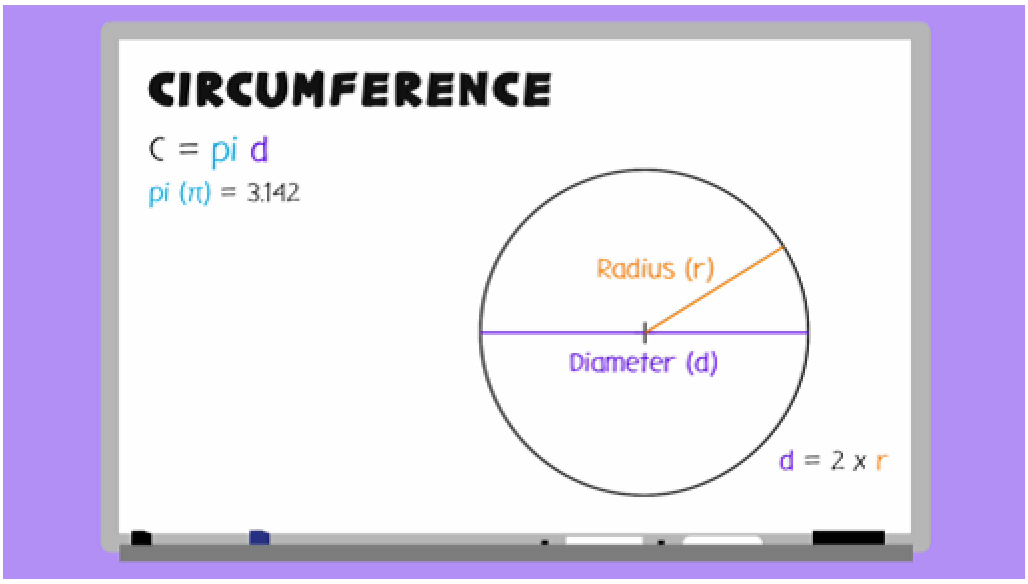
Good work! You can now work out perimeters of simple shapes, including shapes where there are missing lengths. There is just one more shape you need to consider – circles.

Whether it's ribbon around a cake or fencing around a pond, it's useful to be able to work out how much of a material you will need to go around the edge of a circular shape. The final part of your work on perimeter focusses on finding the distance around the outside of a circle.

1.3 Circumference of a circle

You may have noticed that a new term has slipped in to the title of this section. The term circumference refers to the distance around the outside of a circle – its perimeter. The perimeter and the circumference of a circle mean exactly the same, it's just that when referring to circles you would normally use the term circumference.

Video content is not available in this format.



Activity 3: Finding the circumference

1. You have made a cake and want to decorate it with a ribbon.

   The diameter of the cake is 15 cm. You have a length of ribbon that is 0.5 m long. Will you have enough ribbon to go around the outside of the cake?

Figure 11 A round chocolate cake

2. You have recently put a pond in your garden and are thinking about putting a fence around it for safety. The radius of the pond is 7.4 m.

   What length of fencing would you require to fit around the full length of the pond? Round your answer up to the next full metre.

Figure 12 A round garden pond

Answer

1. d = 15 cm

   Using the formula $C = \pi d$

   $C = 3.142 \times 15$

   $C = 47.13$ cm

Since you need 47.13 cm and have ribbon that is 0.5 m (50 cm) long, yes, you have enough ribbon to go around the cake.

2. $C = \pi d$

   $C = 3.142 \times 14.8$

   $C = 46.5016$ m which is 47 m to the next full metre.

You should now be feeling confident with finding the perimeter of all types of shapes, including circles. By completing Activity 3, you have also re-capped on using formulas and rounding.

The next part of this section looks at finding the area (space inside) a shape or space. As mentioned previously, this is incredibly useful in everyday situations such as working out how much carpet or turf to buy, how many rolls of wallpaper you need or how many tins of paint you need to give the wall two coats.

Summary

In this section you have learned:

- that perimeter is the distance around the outside of a space or shape
- how to find the perimeter of simple and more complex shapes
- how to use the formula for finding the circumference of a circle.

2 Area

The area of a shape or space is the amount of space inside it. This applies to only two dimensional (flat) shapes. If we are dealing with a three dimensional shape, the space inside this is called the volume. Since perimeter is the measure of a length, the units it is measured in are cm, m, km etc.

As area is a measure of space rather than distance, it is measured in square units. This could be square metres, square centimetres, square feet and so on. You will often see these written as cm^2, m^2, ft^2, etc. Over the next few pages you will learn how to find the area of simple shapes, compound shapes and circles.

2.1 Area of simple shapes

The simplest shapes to begin with when looking at area are squares and rectangles. If you look at the rectangle below you can see that it's 6 cm long and 3 cm wide. If you count the squares, there are 18 of them. The area of the shape is 18 cm^2.

It is not always possible (or practical) to count the squares in a shape or space but it's a useful illustration to help you understand what area is. More practically, to find the area, (A) of a square or a rectangle, you would multiply the base by the height.

In the example below $A = 6 \times 3 = 18$ cm^2.

Figure 13 Finding the area of a rectangle

Triangles are another shape that you can find the area of relatively simply. If you think of a triangle, it is really just half of a rectangle. This is most easy to see with a right-angled triangle as shown below. You can see that the actual triangle (in yellow) is simply a rectangle that has been diagonally cut in half.

In order to find the area of the triangle then, you simply multiply the base by the height (as you would for a rectangle) and then halve the answer.

Sometimes this is shown as the formula:

$$A = (b \times h) \div 2$$

where b is the base of the triangle and h is the vertical height.

For the triangle below then, you would do:

$$A = (5 \times 4) \div 2$$
$$A = 20 \div 2$$
$$A = 10 \text{ cm}^2$$

Figure 14 Finding the area of a right-angled triangle

This formula remains the same for any triangle. Take a look at the triangle below. It's a bit less obvious than with the example above but if you were to take the two yellow sections way and put them together, you would end up with a shape exactly the same size as the orange triangle. The area of this triangle can be found in the same way as the previous one:

$$A = (b \times h) \div 2$$
$$A = (4 \times 7) \div 2$$

$A = 28 \div 2$

$A = 14\ \text{cm}^2$

Figure 15 Finding the area of a triangle

The last basic shape you learn to find the area of is the trapezium. You will need to use a simple formula for this shape (don't panic when you see it, it looks scary but it really is quite easy to use!)

A trapezium looks like any of the shapes below.

Figure 16 Examples of trapezium shapes

In order to work out the area of a trapezium you just need to know the vertical height and the length of the top and bottom sides. Traditionally, the length of the top is called *'a'*, the length on the bottom is *'b'* and the vertical height is *'h'*. Once this is clear you can then use the formula:

$A =$

Figure 17 Dimensions of a trapezium

Let's take a look at an example on how to work out the area of the trapezium below. We can see that the top length (a) = 12 cm. The bottom length (b) = 20 cm, and the height (h) = 13 cm.

Using these values and the formula:

$A =$

$A =$

$A =$

$A = 208\ \text{cm}^2$

Figure 18 Finding the area of a trapezium

Now that you have seen how to work out the area of several basic shapes, it's time to put your skills to the test. Have a go at the activity below. Don't forget that, just as with perimeter, before you can begin any calculations you must make sure all measurements are in the same units.

Activity 4: Finding the area

Work out the area of each of the shapes below.

1.

Figure 19 Finding the area – Question 1

Answer

1. If working in cm: 1.6 m = 160 cm, so A = 160 × 95 = 15,200 cm^2

If working in m: 95 cm = 0.95 m, so A = 1.6 × 0.95 = 1.52 m^2

2.

Figure 20 Finding the area – Question 2

Answer

2. The two measurements we need for the triangle are the base (30 cm) and the vertical height (17 cm). Don't be fooled by the diagonal length of 46 cm, you do not need it for the area!

   $A = (b \times h) \div 2$

   $A = (30 \times 17) \div 2$

   $A = 510 \div 2$

   $A = 255\ \text{cm}^2$

3.

Figure 21 Finding the area – Question 3

Answer

3. If working in mm: 14 cm = 140 mm

   $A = (b \times h) \div 2$

   $A = (60 \times 140) \div 2$

   $A = 8400 \div 2$

   $A = 4200\ \text{mm}^2$

   If working in cm: 60 mm = 6 cm

   $A = (b \times h) \div 2$

   $A = (6 \times 14) \div 2$

   $A = 84 \div 2$

   $A = 42\ \text{cm}^2$

4.

Figure 22 Finding the area – Question 4

Answer

4. Top length (a) = 8 cm

   Bottom length (b) = 15 cm

   Height (h) = 9 cm

   Using the formula for the area of a trapezium:

   $A =$

   $A =$

   $A =$

   $A = 103.5\ \text{cm}^2$

Now that you've mastered finding the area of basic shapes, it's time to look at compound shapes.

A compound shape is just a shape that is made from more than one basic shape. Rarely will you find a floor space, garden area or wall that is perfectly rectangular. More often than not it will be a combination of shapes. The good news is that, to find the area of compound shapes, you simply split them up into their basic shapes, find the area of each of these, and then add them up at the end!

2.2 Area of compound shapes

Take a look at the shape below; this is an example of a compound shape. Whilst you cannot find the area of this shape as it is by using a formula as you have done previously, you can split it into two basic shapes (rectangles) and then use your existing knowledge to work out the area of each of these shapes.

Figure 23 Finding the area of a compound shape

You should be able to see that you can split this shape into two rectangles. It does not matter which way you split it (horizontally or vertically), you will get the same answer at the end.

Splitting horizontally:

Figure 24 Splitting a compound shape horizontally to find the area

You now have two rectangles. To work out the area of rectangle ①, you do $A = 9 \times 5 = 45\ \text{cm}^2$.

To work out the area of rectangle ②, you do $A = 10 \times 4 = 40\ \text{cm}^2$.

Now that you have the area of both rectangles, simply add them together to find the area of the whole shape:

$$45 + 40 = 85\ \text{cm}^2$$

You need to be careful that you are using the correct measurements for base and height of each rectangle (the measurements in red). In this example, the lengths of 15 cm and 5 cm (in black) are not required.

If you choose to split the shape vertically:

Figure 25 Splitting a compound shape vertically to find the area

Again, you now have two rectangles. To work out the area of rectangle ①, you do $A = 5 \times 5 = 25\ \text{cm}^2$.

To work out the area of rectangle ②, you do $A = 15 \times 4 = 60\ \text{cm}^2$.

Now that you have the area of both rectangles, simply add them together to find the area of the whole shape:

$$25 + 60 = 85\ \text{cm}^2$$

Again, you need to be careful that you are using the correct measurements for base and height of each rectangle (the measurements in red). In this example, the lengths of 9 cm and 10 cm (in black) are not required.

You will notice that regardless of which way you choose to split the shape, you arrive at the same answer of 85 cm^2.

The best way for you to practise this skill is to try a few examples for yourself. Have a go at the activity below and then check your answers.

Activity 5: Finding the area of compound shapes

Work out the area of the shapes below.

1.

Figure 26 Finding the area of compound shapes – Question 1

Answer

1. Splitting vertically:

   $6 \times 8 = 48\ cm^2$

   $15 \times 4 = 60\ cm^2$

   $48 + 60 = 108\ cm^2$

   Splitting horizontally:

   $12 \times 6 = 72\ cm^2$

   $9 \times 4 = 36\ cm^2$

   $72 + 36 = 108\ cm^2$

2.

Figure 27 Finding the area of compound shapes – Question 2

Answer

2. The missing lengths are 13 cm (vertical length) and 8 cm (horizontal length).

   Splitting vertically:

   $13 \times 8 = 104\ cm^2$

   $12 \times 9 = 108\ cm^2$

   $104 + 108 = 212\ cm^2$

   Splitting horizontally:

   $20 \times 9 = 180\ cm^2$

   $4 \times 8 = 32\ cm^2$

   $180 + 32 = 212\ cm^2$

Now that you can calculate the area of basic and compound shapes, there is just one last shape you need to be able to find the area of: circles. Similarly to finding the perimeter of a circle, you'll need to use a formula involving the Greek letter π.

2.3 Area of a circle

The formula to find the area of a circle is similar to the one you have already used to find the circumference.

Area of a circle = pi × radius^2

$A = \pi r^2$

Hint: Remember that when you square a number you simply multiply it by itself, radius^2 is therefore simply radius × radius.

Figure 28 The circumference and area of a circle

Let's look at an example.

Figure 29 The radius of a circle

In the circle above you can see that the radius is 8 cm. To find the area of the circle we use:

$A = \pi r^2$

$A = 3.142 \times 8 \times 8$

$A = 201.088\ \text{cm}^2$

Before you try some on your own, let's take a look at one further example.

Figure 30 The diameter of a circle

This circle has a diameter of 12 cm. In order to find the area, you first need to find the radius. Remember that the radius is simply half of the diameter and so in this example radius = 12 ÷ 2 = 6 cm.

We can now use:

$A = \pi r^2$

$A = 3.142 \times 6 \times 6$

$A = 113.112\ \text{cm}^2$

Try a couple of examples for yourself before moving on to the next part of this section.

Activity 6: Finding the area of a circle

1. Find the area of the circle shown below. Give your answer to one decimal place.

Figure 31 Finding the area of a circle – Question 1

2. You are designing a mural for a local school and need to decide how much paint you need. The main part of the mural is a circle with a diameter of 10 m as shown below. Each tin of paint will cover an area of 5 m^2. You will need to use two coats of paint. How many tins of paint should you buy?

Figure 32 Finding the area of a circle – Question 2

Answer

1. Using the formula: $A = \pi r^2$

   $A = 3.142 \times 4 \times 4$

   $A = 50.272\ \text{m}^2$

   $A = 50.3\ \text{m}^2$ to 1 d. p.
2. You need to find the area of the circle first. Since the diameter of the circle is 10 m, the radius is 10 m ÷ 2 = 5 m.

   Using the formula: $A = \pi r^2$

   $A = 3.142 \times 5 \times 5$

   $A = 78.55\ \text{m}^2$

   So the area of the circle you need to paint is 78.55 m^2

   Since you need to give 2 coats of paint, you need to double this number:

   $78.55 \times 2 = 157.1\ \text{m}^2$

   You now need to work out how many tins of paint you need. As one tin of paint covers 5 m^2 you need to do:

   $157.1 \div 5 = 31.42$ tins

   Since you must buy whole tins of paint, you will need to buy 32 tins.

You have now learned all you need to know about finding the area of shapes! The last part of this section is on finding the volume of solid shapes – or three-dimensional (3D) shapes .

Summary

In this section you have learned:

- that area is the space inside a two-dimensional (2D) shape or space
- how to find the area of rectangles, triangles, trapeziums and compound shapes
- how to use the formula to find the area of a circle.

3 Volume

The volume of a shape is how much space it takes up. You might need to calculate the volume of a space or shape if, for example, you wanted to know how much soil to buy to fill a planting box or how much concrete you need to complete your patio.

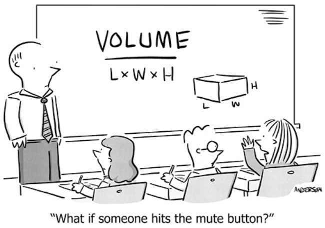
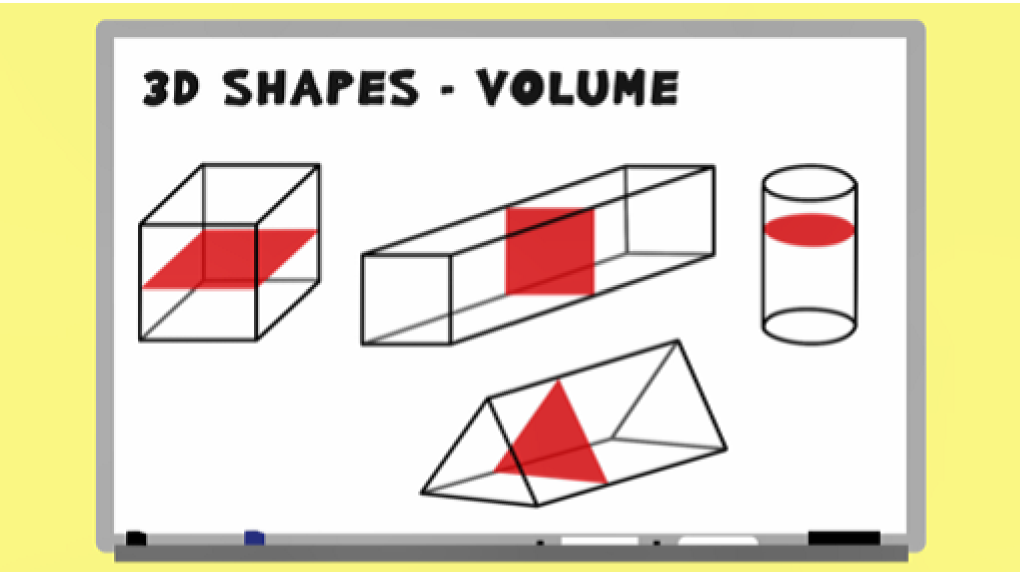


Figure 33 A volume cartoon

You'll need your area skills in order to calculate the volume of a shape. In fact, as you already know how to calculate the area of most shapes, you are one simple step away from being able to find the volume of most shapes too!

Video content is not available in this format.



Example: Calculating volume 1

Figure 34 Calculating volume 1

The cross section on this shape is the L shape on the front. In order to work out the area you'll need to split it up into two rectangles as you practised in the previous part of this section.

Splitting vertically:

$$\text{Rectangle 1} = 7 \times 4 = 28\ \text{cm}^2$$

Rectangle 2 = 5 × 2 = 10 cm^2

Area of cross section = 28 + 10 = 38 cm^2

Now you have the area of the cross section, multiply this by the length to calculate the volume.

V = 38 × 10 = 380 cm^3

Example: Calculating volume 2

The last example to look at is a cylinder. The cross section of this shape is a circle. You'll need to use the formula to find the area of a circle in the same way you did in the previous part of this section.

Figure 35 Calculating volume 2

You can see that the circular cross section has a radius of 8 cm. To find the area of this circle, use the formula:

$A = \pi r^2$

A = 3.142 × 8 × 8

A = 201.088 cm^2

Now you have the area, multiply this by the length of the cylinder to calculate the volume.

V = 201.088 × 15 = 3016.32 cm^3

Now try yourself in the activity below.

Activity 7: Calculating prism volume

Work out the volume of the 3D trapezium (trapezoidal prism) shown below.

Hint: Go back to the section on area and remind yourself of the formula to find the area of a trapezium.

Figure 36 Calculating the volume of a prism

Answer

The cross section is a trapezium so you will need the formula:

A =

A =

A =

A =

$A = 35\ \text{cm}^2$

Now you have the area of the cross section, multiply it by the length of the prism to calculate the volume.

$V = 35 \times 20 = 700\ \text{cm}^3$

The final part of this session will look at scale drawings and plans. It will require your previous knowledge of ratio as scale drawings are really just another application of ratio.

Summary

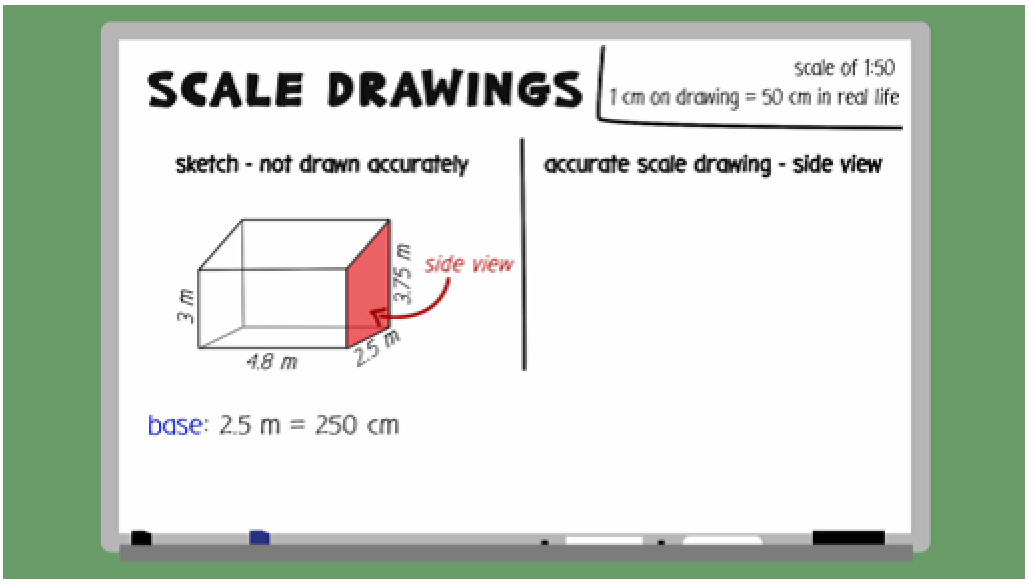
In this section you have learned:

- that volume is the space inside a 3D shape or space
- how to find the volume of prisms such as cuboids, cylinders and triangular prisms.

4 Scale drawings and plans

Given that you already have the knowledge you need around measures and ratios, scale drawings are simply just another application of these skills.

Video content is not available in this format.



If you are given the scale drawing and asked to work out the real-life size, rather than dividing by the scale, you multiply by it. Take a look at the example below.

Example: Calculating scale

A scale drawing has been drawn below of a shed that a garden planner wants to build. The scale used for the drawing is 1:20. The area that the shed will be built on is a rectangle which measures 3.1 m by 2.8 m.

Will the building fit into the space allocated?

Figure 37 Calculating scale

Method

Since 1 cm on the diagram represents 20 cm in real life, you do:

Horizontal length: 12.5 × 20 = 250 cm = 2.5 m

Vertical length: 15.2 × 20 = 304 cm = 3.04 m

Since both lengths for the shed are shorter than the lengths given for the area of land, you know the shed will fit.

Now have a go at an example for yourself.

Activity 8: Finding the length of a slope

For this question you will need a pen or pencil, paper and a ruler.

Jane has a raised vegetable patch. She plans to build a slope leading up to the vegetable patch. Jane will cover the slope with grass turf.

She draws this sketch of the cross section of the slope.

Figure 38 Finding the length of a slope

Jane will use a scale diagram to work out the length of the slope. She wants to use a scale of 1:10.

Draw a scale diagram of the slope for Jane. Use it to find the length of the slope.

Answer

Base of patch = 125 ÷ 10 = 12.5 cm

Height of patch = 45 ÷ 10 = 4.5 cm

The length of the slope on your drawing should therefore measure around 13.2 cm and when you use the scale of 1:10:

$$13.2 \times 10 = 132 \text{ cm or } 1.32 \text{ m in real life}$$

Answers in the range of 1.30 m to 1.36 m are considered accurate and correct.

Summary

In this section you have:

- applied your ratio skills to the concept of scale plans and drawings
- interpreted scale plans and decided upon a suitable scale for a drawing.

5 Session 4 summary

Well done! You have now completed the fourth and final session of the course. If you have identified any areas that you need to work on, please ensure you refer back to this section of the course.

You should now be able to:

- understand the difference between perimeter, area and volume and be able to calculate these for both simple and more complex shapes
- know that volume is a measure of space inside a 3D object and calculate volumes of shapes in order to solve practical problems
- draw and use a scale drawing or plan.

All of the skills above will help you with tasks in everyday life. Whether you are at home or at work, number skills are essential skills to have.

You are now ready to test the knowledge and skills you've learned throughout each section in the end-of-course quiz (Session 4 compulsory badge quiz). Good luck!

6 End-of-course quiz

Now it's time to complete end-of-course quiz (Session 4 compulsory badge quiz). It's similar to previous quizzes, but in this one there will be 15 questions.

End-of-course quiz

Open the quiz in a new window or tab then come back here when you're done.

Remember, this quiz counts towards your badge. If you're not successful the first time, you can attempt the quiz again in 24 hours.

7 Bringing it all together

Congratulations on completing *Everyday maths 2*. We hope you have enjoyed the experience and now feel inspired to develop your maths skills further.

Throughout this course you have developed your skills within the following areas:

- understanding and using whole numbers and decimal numbers, and understanding negative numbers in the context of money and temperature
- solving problems requiring the use of the four operations and rounding answers to a given degree of accuracy
- understanding and using equivalences between common fractions, decimals and percentages
- working out simple and more complex fractions and percentages of amounts. Calculating percentage change and using reverse percentages
- adding and subtracting decimals up to two decimal places
- solving ratio problems where the information is presented in a variety of ways
- understanding the order of operations and using this to work with formulas
- solving problems requiring calculations with common measures, including money, time, length, weight, capacity and temperature
- converting units of measure in the same system and those in different systems
- extracting and interpreting information from tables, diagrams, charts and graphs
- collecting and recording discrete data, and organising and representing information in different ways
- finding the mean, median and range of a group of numbers. Finding the mean from grouped data
- using data to assess the likelihood of an outcome and expressing this in different forms
- working with area, perimeter and volume, scale drawings and plans.

8 Next steps

If you would like to achieve a more formal qualification, please visit one of the centres listed below with your OpenLearn badge. They'll help you to find the best way to achieve the Level 2 Functional Skills qualification in maths, which will enhance your CV.

- **The Bedford College Group**
  Bedford College, Cauldwell St, Bedford, MK42 9AH
  https://www.bedford.ac.uk/ • 01234 291000
- **Tresham College**
  Windmill Avenue, Kettering, Northamptonshire, NN15 6ER
  https://www.tresham.ac.uk/ • 01536 413123
- **Middlesbrough College**
  Dock St, Middlesbrough, TS2 1AD
  https://www.mbro.ac.uk/ • 01642 333333
- **West Herts College**
  Watford Campus, Hempstead Rd, Watford, WD17 3EZ
  https://www.westherts.ac.uk/ • 01923 812345

Acknowledgements

This free course was written by Joanne Davies, West Herts College, using materials belonging to The Open School Trust Ltd. (trading as the National Extension College), in partnership with Bedford College Group, Middlesbrough College and The Open University. Copyright in this material belongs to The Open University, 2019.

Grateful acknowledgement is made to the following sources for permission to reproduce material in this free course:

Session 1 Figure 1 Fruit maths puzzle: Taken from https://puzzlersworld.com/

Session 1 Figure 2 Rounding up and down: Rounding arrows - © Garganel | Dreamstime.com

Session 1 Figure 6 Smarties in different colours: Smarties - © Floortje / iStock / Getty Images Plus

Session 1 Figure 13 Scones on a plate: - © from_my_point_of_view / iStock / Getty Images Plus

Session 1 Figure 21 A calculation using the four operations: What is the answer - Taken from Cazoom Maths

Session 1 Figure 22 The BIDMAS order of operations: Order of operation - jennyskene

Session 1 Figure 23 Inverse operations: Inversion - 4mulafun

Session 2 Figure 5 Different currency notes: Money image - © MarioGuti / iStock / Getty Images Plus

Session 2 Figure 11 A radio alarm clock: alarm - © Jeff Lueders / 123 Royalty Free

Session 2 Figure 20 Distance, speed and time formulas: Average speed - Taken from www.mathopolis.com

Session 3 Figure 11 Degrees of a circle: Degrees - © neyro2008 / 123 Royalty Free

Session 3 Figure 15 A graph to show the population of the Kakapo bird on Stewart Island: Kakapo birds graph - Taken from www.bbc.co.uk/bitesize

Session 3 Figure 19 A mountain range of different sized peaks: Peaks and troughs - © Jianzhou(lwtt93) Li / iStock / Getty Images Plus

Session 3 Figure 20 Below average and mean average: Snails - Adapted from https://investforyourself.blog/2017/05/03/using-reversion-to-mean-for-reit-investments/. Publisher unknown

Session 3 Figure 23 Probability – the odds are you are already using it: Probability cartoon - © Mark Anderson www.andertoons.com

Session 4 Figure 1 Floor plan of a house: Floor plan image: Maryna Semeshchuk / 123 Royalty Free

Session 4 Figure 11 A round chocolate cake: Cake image - robynmac / iStock / Getty Images Plus

Session 4 Figure 12 A round garden pond: Pond in garden - © roseov / 123 Royalty Free

Session 4 Figure 33 A volume cartoon: cartoon classroom: Volume - © Mark Anderson www.andertoons.com