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Everyday maths 1 (Northern Ireland)

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Intellectual property

Contents

Session 1: Working with numbers

Introduction

It is very difficult to cope in everyday life without a basic understanding of numbers.

Calculators can be very useful, for example helping you to check your working out, or converting fractions to decimals.

To complete the activities in this course you will need some notepaper, a pen for taking notes and working out calculations and a calculator.

Session 1 includes many examples of numeracy from everyday life, with lots of learning activities related to them that involve whole numbers, fractions, decimals, percentages, ratios and proportion.

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

- work with whole numbers
- use rounding
- understand fractions, decimals and percentages, and the equivalencies between them
- use ratios and proportion
- understand word formulas and function machines.

Video content is not available in this format.

1 Whole numbers

What is a whole number? The simple answer is ‘any number that does not include a fraction or decimal part’.

So for example, 3 is a whole number, but $3\frac{1}{2}$ or 3.25 are NOT whole numbers.

Numbers can be positive or negative.

Positive numbers can be written with or without a plus (+) sign, so 3 and +3 are the same.

Negative numbers always have a minus (–) sign in front of them, such as –3, –5 or –2.

1.1 Positive numbers and place value

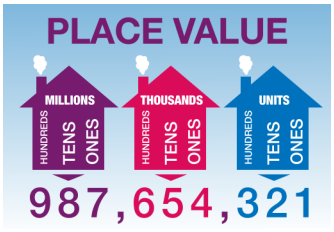


Figure 1 Place value

Let’s look at positive numbers in more detail.

The place value of a digit in a number depends on its position or place in the number:

The value of 8 in 58 is 8 units.

The value of 3 in 34 is 3 tens.

The value of 4 in 435 is 4 hundreds.

The value of 6 in 6 758 is 6 thousands.

Activity 1: Working with place value

1. Write 4 025 in words.

Th	H	T	U
4	0	2	5

Answer

4 025 in words is four thousand and twenty-five.

2. Write six thousand, four hundred and seventy-two in figures.

Th	H	T	U
six	four	seven	two

Answer

Six thousand, four hundred and seventy-two in figures is 6 472.

3. Here are the results of an election to be school governor at Hawthorn School:

   John Smith: 436 votes
   Sonia Cedar: 723 votes
   Pat Kane: 156 votes
   Anjali Seedher: 72 votes

   Who won the election?

   Check your answer with our feedback before continuing.

Answer

The person who wins the election is the person who gets the most votes.

To find the biggest number we need to compare the value of the first digit in each number. If this is the same for any of the numbers, then we need to go on to compare the value of the second digit in each number and so on.

The value of the first digit in 436 is 4 hundreds.
The value of the first digit in 723 is 7 hundreds.
The value of the first digit in 156 is 1 hundred.
The value of the first digit in 72 is 7 tens.

Comparing the values of the first digit in each number tells us that the biggest number is 723, so Sonia Cedar is the winner of the election.

1.2 Numbers with zeros

The zero in a number plays a very important part in deciding its value.
Four hundred is written:

H	T	U
4	0	0

We need to put in the two zeros to show that it is four hundred and not just four.
Six hundred and seven is written:

H	T	U
6	0	7

We need the zero to show that there are no tens.

Activity 2: Place value

Fill in the boxes to show the value of each figure. The first two are done for you.

Number	Th	H	T	U
584		5	8	4
690		6	9	0
708		*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
302		*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
4 290	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
5 060	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
2 100	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*
3 009	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*	*Provide your answer...*

Answer

The answers are as follows:

Number	Th	H	T	U
584		5	8	4
690		6	9	0
708		7	0	8
302		3	0	2
4 290	4	2	9	0

5 060	5	0	6	0
2 100	2	1	0	0
3 009	3	0	0	9

1.3 Writing large numbers

You may need to read numbers much larger than those we have looked at previously.
Take the number 9 046 251. The value of each digit is as follows:

9 millions

0 hundred thousands

4 ten thousands (or 40 thousand)

6 thousands

2 hundreds

5 tens

1 unit

To make large numbers easier to read, we put them in groups of three digits starting from the right:

6532 is often written as 6 532 (or 6,532).

25897 is often written as 25 897 (or 25,897).

596124 is often written as 596 124 (or 596,124).

7538212 is often written as 7 538 212 (or 7,538,212).

Using a place value grid can also help you to read large numbers. The place value grid groups the digits for you, making the whole number easier to read.
Look at the place value grid below. It only goes up to millions, but we can use place value to record numbers of any size, including numbers much greater than this.

Million	Thousand					
Millions	Hundreds of thousands	Tens of thousands	Thousands	Hundreds	Tens	Units

You may also want to watch this clip to help you to understand place value with large numbers:

View at: youtube:iInDdBkfAiQ

Example: Reading large numbers using a place value grid

How would you say the number in the place value grid?

Million	Thousand					
Millions	**Hundreds of thousands**	**Tens of thousands**	**Thousands**	**Hundreds**	**Tens**	**Units**
7	4	0	6	8	9	4

Method
You need to say the number a section at a time:

Seven (7) million,

four hundred and six (406) thousand,

eight hundred and ninety-four (894).

So the number is seven million, four hundred and six thousand, eight hundred and ninety-four (7 406 894).

Now try the following activity, using the place value grid to help you if needed.

Activity 3: Large numbers

1. Write the following numbers in words:
   a. 765 228
   b. 1 655 501
   c. 3 487 887
2. Write the following words in numbers:
   a. Six hundred and eight thousand, nine hundred and ten.
   b. Two million, seven hundred and eleven thousand, one hundred and six.
   c. Eight million, nine hundred thousand, four hundred.
3. Put the following numbers in size order, starting with the smallest:
   496 832
   1 260 802
   258 411

482 112
1 248 758
1 118 233

Answer

1. The answers are as follows:
   a. Seven hundred and sixty-five thousand, two hundred and twenty-eight.
   b. One million, six hundred and fifty-five thousand, five hundred and one.
   c. Three million, four hundred and eighty-seven thousand, eight hundred and eighty-seven.
2. The answers are as follows:
   a. 608 910
   b. 2 711 106
   c. 8 900 400
3. The correct order is:
   258 411
   482 112
   496 832
   1 118 233
   1 248 758
   1 260 802

1.4 Negative numbers

So far you have only looked at positive numbers, but negative numbers are just as important. Negative numbers have a minus sign (–) in front of them.

Some examples of where negative numbers will apply to real life is with temperatures and bank balances, although hopefully our bank balances will not display too many negatives!

You might have encountered negative numbers in weatherreports, such as temperatures like –2°C, which indicate temperatures belowfreezing. Freezing point, which is 0 degrees Celsius, is where water turns intoice. If you ever have an overdraft at the bank, you may see minus signs next tothe figures. If a bank statement reads –£30, for example, this tells you howmuch you're overdrawn. In other words, what you owe the bank!

Where have you seen negative numbers recently? Look at this thermometer:

Figure 2 negative numbers on a thermometer

It shows us that:

- –10°C is a lower temperature than –5°C
- 10°C is a higher temperature than –10°C.

Hint: ‘Lower’ means ‘less than’.

‘Higher’ means ‘greater than’.

The less than < and greater than > symbols are used to compare temperatures, indicating if one temperature is lower or higher than another.

Example: 25°C > 10°C

This means that 25 degrees Celsius is greater than 10 degrees Celsius.

The lower the temperature, the colder it is, the higher thetemperature, the warmer it is.

Activity 4: Using negative numbers in everyday life

1. The following table shows the temperatures in several cities on one day.

City	Temperature
A	–2°C
B	–5°C
C	–1°C
D	–8°C
E	–3°C

Which are the coldest and warmest cities?

2. A particular brand of ice cream includes the following note in its storing instructions:

For best results, store in temperatures between –10°C and –6°C

If your freezer’s temperature was –11°C, would it be OK to keep this ice cream in it?

Answer

1. City D is the coldest because it has the lowest temperature. City C is the warmest because it has the highest temperature.
2. No, because –11°C is colder than the recommended range of between –10°C and –6°C. Keeping the ice cream in your freezer would probably damage the ice cream.

You have now seen how we use negative numbers in everyday life, for example bank balances and temperatures. Try practising using them when you are out and about. You will also use this skill within some simple questions that are coming up.

1.5 Working with whole numbers

The following activities cover everything in the whole numbers section. As you attempt the activities, look for key words to identify what the question is asking you to do.

Remember to check your answers once you have completed the questions.

Activity 5: Looking at numbers

1. Look at this newspaper headline:

Figure 3 A newspaper headline

   a. What number does the 9 represent in the newspaper headline?
   b. How many thousands are there?
   c. Look at the details below. Who won the *Pop Idols* competition?

Will: 4 850 000 votes
Gareth: 4 803 000 votes

2. Look at the data in the following table. It gives the temperatures of five cities on a Monday in January.

City	Temperature
London	0°C
Paris	–1°C
Madrid	10°C
Delhi	28°C
Moscow	–10°C

a. Which city was the coldest?
b. Which city was the warmest?
c. How many cities have a temperature below 5°C?

Answer

1. The answers are as follows:
   a. 9 million
   b. 653 thousand
   c. Will
2. The answers are as follows:
   a. Moscow
   b. Delhi
   c. London, Paris and Moscow

1.6 Add and subtract large numbers

Addition

We add large numbers in the same way as we add smaller numbers:

View at: youtube:vjMo92dR7Ds

Activity 6: Adding whole numbers

Complete the following tasks without using a calculator:

1. 8 936 + 453
2. 3 291 + 2 520
3. 35 + 214 + 9 963
4. 28 550 + 865
5. 243 552 + 64 771
6. 698 441 + 323 118

Remember you can check your calculations using the inverse method, which means using the opposite type of sum to check that your answer is correct. For example, you can use subtraction to check that an addition calculation is correct:

630 + 295 = 925 (addition)

925 – 295 = 630 (subtraction to check)

Answer

The answers are as follows:

1. 9 389
2. 5 811
3. 10 212
4. 29 415
5. 308 323
6. 1 021 559

Subtraction

There are different methods that can be used to subtract numbers. You need to find the method that works for you.

Decomposition method

For example:

843 – 266

Follow the following steps:

1.
   a. Start with the units: subtract 6 from 3. (*This can't be done.*)
   b. There are four tens in the tens column. One of these can be given to the units column.

c. If 10 is added to the original 3 we now have 13 in the units column: 13 – 6 = 7.
d. 7 is placed on the answer line in the units column.

	C	D	U
		3	13
	8	~~4~~	3
–	2	6	6
			7

2.

a. Now move on to the tens column: subtract 6 from 3. There are only three tens left, because one 10 was added to the units column. (*This can't be done.*)
b. There are eight hundreds in the hundreds column. Taking one from the hundreds column and moving it to the tens column makes 13 in the tens column: 13 – 6 = 7.
c. 7 is placed on the answer line in the tens column.

	C	D	U
	7	13	13
	~~8~~	~~4~~	3
–	2	6	6
		7	7

3.

a. There is now a 7 in the hundreds column.
b. Subtract 3 from 7: 7 – 2 = 5.
c. This is placed on the answer line in the hundreds column.

	C	D	U
	7	13	13
	~~8~~	~~4~~	3
–	2	6	6
	5	7	7

The final answer is 577.

You need to be careful when trying to subtract with zeros; for example, 800 – 427. The following video shows the decomposition method in full, including dealing with zeros:

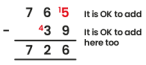
View at: youtube:6UCV8919-ZQ

'Borrow and pay back' method

For example:

765 – 39

Follow the following steps:



Activity 7: Subtracting whole numbers

Complete this activity using the subtraction method that you are most familiar with. Do not use a calculator.

1. 9 965 – 742
2. 8 163 – 7 481
3. 27 364 – 9 583
4. 600 987 – 4 500
5. 975 046 – 74 308
6. 587 342 – 369 453

Remember you can check your calculations using the inverse method, which means using subtraction to check that your answer to an addition calculation is correct. For example:

630 + 295 = 925 (addition)

925 – 295 = 630 (subtraction to check)

Answer

The answers are as follows:

1. 9 223
2. 682
3. 17 781
4. 596 487
5. 900 738
6. 217 889

1.7 Multiplication

Multiplication by 10, 100 and 1 000

×10

To multiply a whole number by 10, we write the number then add one zero on the end. For example:

2 × 10 = 20 (2 × 1 = 2, then add a zero)

6 × 10 = 6**0**

10 × 10 = 1**00**

×100

When we multiply a whole number by 100, we add two zeros to the end of the number. For example:

3 × 100 = 3**00**

25 × 100 = 2 5**00**

60 × 100 = 6 0**00**

×1 000

When we multiply a whole number by 1 000, we add three zeros to the end of the number. For example:

4 × 1 000 = 4 **000**

32 × 1 000 = 32 **000**

50 × 1 000 = 50 **000**

Now try the following activity.

Activity 8: Multiplying whole numbers by 10, 100 and 1 000

Now try the following:

1. 7 × 10
2. 32 × 10
3. 120 × 10
4. 8 × 100
5. 21 × 100
6. 520 × 100
7. 3 × 1 000
8. 12 × 1 000
9. 45 × 1 000
10. Pens cost 31 pence each. How much would it cost for a pack of ten pens?
11. A supermarket buys boxes of cereal in batches of 100. If they buy 19 batches, how many boxes is this?
12. Seven people win £1 000 each on the lottery. How much money is this altogether?

Answer

1. 70
2. 320
3. 1 200
4. 800
5. 2 100
6. 52 000
7. 3 000
8. 12 000
9. 45 000
10. 310 pence (or £3.10)
11. 1 900 boxes of cereal
12. £7 000

Multiples and square numbers

When dealing with multiplication, it is important to know the meaning of multiples and square numbers.

Multiples

A multiple of a number can be divided exactly by that number. So for example, 12 is a multiple of 2, 3, 4 and 6, because:

$2 \times 6 = 12$

$4 \times 3 = 12$

Activity 9: Looking for multiples

Look at the following row of numbers, and then answer the questions below.

12,17, 300, 24, 30, 39, 2000, 100, 45, 52, 80, 50, 450

1. Which of these numbers are multiples of 2?
2. Which of these numbers are multiples of 3?
3. Which of these numbers are multiples of 5?
4. Which of these numbers are multiples of 10?
5. Which of these numbers are multiples of 50?
6. Which of these numbers are multiples of 100?
7. Which of these numbers are multiples of 1000?

Answer

1. 12, 24, 30, 50, 52, 80, 100,300, 450, 2000 are multiples of 2.
- $2 \times 6 = 12$
- $2 \times 12 = 24$
- 2 15 = 30
- $2 \times 25 = 50$
- $2 \times 26 = 52$
- $2 \times 40 = 80$
- $2 \times 50 = 100$
- $2 \times 150 = 300$
- $2 \times 225 = 450$
- $2 \times 1000 = 2000$

2. 12, 24, 30, 39, 45, 300 and450 are multiples of 3.
- $3 \times 4 = 12$
- $3 \times 8 = 24$
- $3 \times 10 = 30$
- $3 \times 13 = 39$
- $3 \times 15 = 45$

- 3 × 100 = 300
- 3 × 150 = 450

3. 30, 45, 50, 80, 100, 300, 450and 2000 are multiples of 5.
- 5 × 6 = 30
- 5 × 9 = 45
- 5 × 10 = 50
- 5 × 16 = 80
- 5 × 20 = 100
- 5 × 60 = 300
- 5 × 90 = 450
- 5 × 400 = 2000

4. 30, 50, 100, 300, 450, 2000are multiples of 10.
- 10 × 3 = 30
- 10 × 5 = 50
- 10 × 8 = 80
- 10 × 10 = 100
- 10 ×30 = 300
- 10 × 45 = 450
- 10 × 200 = 2000

5.50, 100, 300, 450 and 2000 are multiples of 50.
- 50× 1 = 50
- 50× 2 = 100
- 50× 6 = 300
- 50× 9 = 450
- 50× 40 = 2000

6. 100, 300 and 2000 are multiples of 100.
- 100 × 1 = 100
- 100 × 3 = 300
- 100 × 20 = 2000

7. 2000 is a multiple of 1000: 1000 × 2 = 2000

Square numbers

A square number is made when you multiply any whole number by itself. For example:

1 × 1 = 1

2 × 2 = 4

3 × 3 = 9

Hint: Square numbers are commonly shown as: 1^2 (meaning 1 × 1), 2^2 (meaning 2 × 2), 3^2 (meaning 3 × 3), etc.

Activity 10: Identifying square numbers

You have been given the square numbers up to 3. Following the pattern, what are the square numbers from 4 to 12?

Answer

The answers are as follows:

$4 \times 4 = 16$

$5 \times 5 = 25$

$6 \times 6 = 36$

$7 \times 7 = 49$

$8 \times 8 = 64$

$9 \times 9 = 81$

$10 \times 10 = 100$

$11 \times 11 = 121$

$12 \times 12 = 144$

Multiplication methods

There are several ways to multiply, and each method will give you the correct answer as long as you use it correctly. The following videos show you the most common methods.

Standard multiplication

View at: youtube:wayoCIgl08I

Grid method multiplication

View at: youtube:4PcsEtIqei8

Lattice method multiplication

View at: youtube:NDC79an3NNA

Activity 11: Multiplying whole numbers

Choose the method you are most comfortable with and use it to calculate the following sums:

1. 76 × 4
2. 183 × 6
3. 42 × 25
4. 123 × 40
5. 718 × 21
6. 249 × 34
7. 678 × 39
8. A theatre has 85 rows of seats and there are 48 seats in each row. What is the total number of seats?
9. A taxi driver travels 250 miles per day. How many miles are travelled in 15 days?
10. 54 people go on a short coach holiday to the Mourne Mountains. They each pay £199. How much will they pay in total?

Now check your calculations with a calculator before revealing the answers.

Answer

1. 304
2. 1 098
3. 1 050
4. 4 920
5. 15 078
6. 8 466
7. 26 442
8. 4 080 seats
9. 3 750 miles
10. £10 746 in total

1.8 Division

Division by 10, 100 and 1 000

÷ 10

To divide a whole number by 10 (when the number ends in a zero), remove a zero from the end of the number to make it 10 times smaller. For example:

2**0** ÷ 10 = 2

6**0** ÷ 10 = 6

10**0** ÷ 10 = 10

÷ 100

To divide a whole number by 100 (when the number ends in at least two zeros), remove two zeros from the end of the number.

3**00** ÷ 100 = 3

2 5**00** ÷ 100 = 25

6 0**00** ÷ 100 = 60

÷ 1 000

To divide a whole number by 1000 (when the number ends in at least three zeros), remove three zeros from the end of the number.

4 **000** ÷ 1 000 = 4

32 **000** ÷ 1 000 = 32

50 **000** ÷ 1 000 = 50

Activity 12: Dividing by 10, 100 and 1 000

Calculate the following:

1. 70 ÷ 10
2. 32 ÷ 10
3. 120 ÷ 10
4. 8 500 ÷ 100
5. 2 100 ÷ 100
6. 52 000 ÷ 100

7. 34 000 ÷ 1 000
8. 120 000 ÷ 1 000
9. 450 000 ÷ 1 000
10. Rulers are sold in boxes of ten. How many boxes will 350 rulers fill?
11. There are 100 centimetres in 1 metre. What is 18 000 centimetres in metres?
12. Ten people share a lottery win of £16 000. How much money does each person win?

Answer

1. 7
2. 32
3. 12
4. 85
5. 21
6. 520
7. 34
8. 120
9. 450
10. 35 boxes
11. 180 metres
12. £1 600

Short and long division

Short division

Watch the following video about short division to help you complete the activity:

View at: youtube:lRms31-VtJE

Activity 13: Dividing whole numbers (short division)

Calculate the following:

1. 969 ÷ 3
2. 3 240 ÷ 8
3. 7 929 ÷ 9
4. 34 125 ÷ 5
5. 14 508 ÷ 8
6. 80 225 ÷ 4
7. A syndicate of six people wins £135 000 on the lottery. How much will each person get?

8. A factory packs 34 000 fish fingers into boxes of eight. How many boxes are filled?

Please note that some of the answers have remainders.

Answer

1. 323
2. 405
3. 881
4. 6 825
5. 1 813 r4
6. 20 056 r1
7. £22 500 each
8. 4 250 boxes

Long division

Watch the following video about long division to help you complete the activity:

View at: youtube:elUolhfupuA

Activity 14: Dividing whole numbers (long division)

Calculate the following:

1. 648 ÷ 18
2. 377 ÷ 29
3. 298 ÷ 14
4. 1 170 ÷ 18
5. 42 984 ÷ 12
6. Sian earns £12 540 a year. How much does she earn each month?
7. Alun buys a car costing £8 550. He wants to pay for it over 15 months. How much will it cost each month?

Now check your calculations with a calculator before revealing the answers.

Answer

1. 36
2. 13
3. 21 r4
4. 65
5. 3 582
6. £1 045 a month
7. £570 a month

1.9 A note on the four operations

The four operations are addition, subtraction, multiplication and division. You will already be using these in your daily life (whether you realise it or not!). Everyday life requires us to carry out maths all the time – for example, 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.

- **Addition (+)** is used when you want to find the total, or sum, of two or more amounts.
- **Subtraction (−)** 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 out how much change you are owed after spending an amount of money.
- **Multiplication (×)** is also used for totals and sums, but when there is more than one of the same number. For example, if you bought five packs of apples that cost £1.20 each, to find out the total amount of money you would spend the sum would be 5 × £1.20.
- **Division (÷)** is used when sharing or grouping items. For example, to find out how many doughnuts you can buy with £6 if one doughnut costs £1.50, you would use the sum £6 ÷ £1.50.

Checking calculations

You should always double-check your calculations using an alternative method. There are different methods you can use, and the one you choose will probably depend on the calculation.

One very good way of checking calculations is to carry out a reverse calculation, or an inverse calculation as it was called earlier in this session. This is where you use the opposite type of sum (or opposite operation) to check your answer:

- Addition (+) and subtraction (–) are opposite operations.
- Multiplication (×) and division (÷) are opposite operations.

If your check results in the same answer, it means that your original sum is correct too. For example, you may have made the following calculation:

200 – 168 = 32

A way of checking this would be:

32 + 168 = 200

Alternatively, if you wanted to check the following calculation:

80 × 2 = 160

A way of checking this would be:

$160 \div 2 = 80$

Summary

In this section you have:

- learned how to read, write, order and compare positive numbers
- looked at different ways of using negative numbers in everyday life
- carried out calculations
- learned how to use the inverse method to check answers.

2 Rounding

If you are out on a shopping trip, being able to quickly estimate the total cost of your shopping could help you to decide whether you have enough money to pay for it. Approximating answers to calculations is a very useful skill to have.

Remember the rounding rhyme that will help you:

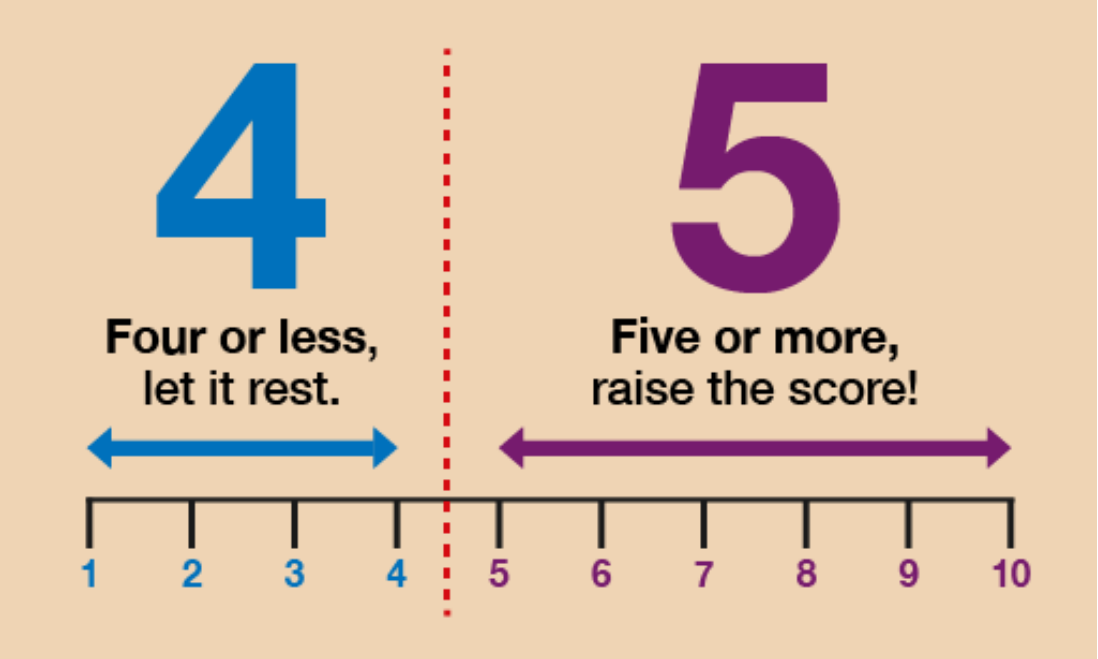


Figure 4 ‘Four or less, let it rest. Five or more, raise the score!’

Watch this video to refresh your knowledge on rounding. You should make notes throughout:

View at: youtube:LGRoPAPMZhA

Now try the following activities. Remember to check your answers once you have completed the questions.

Activity 15: Rounding to 10, 100 and 1 000

1. Round these numbers to the nearest 10:
   a. 64
   b. 69
   c. 65
   d. 648
   e. 271
   f. 587

Check with our suggestions before continuing.

Answer

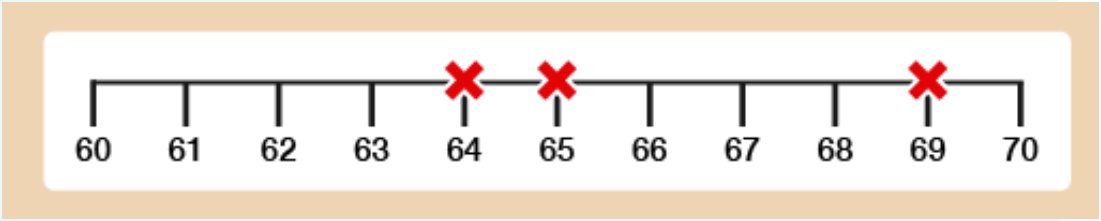


Figure 5 A number line

You can see in Figure 5 that:

a. 64 rounded to the nearest 10 is 60.
b. 69 rounded to the nearest 10 is 70.
c. 65 rounded to the nearest 10 is 70. (Remember: when a number is exactly halfway, you always round up. As the rhyme goes, 'Five or more, raise the score!')

The other answers are as follows:

d. 648 rounded to the nearest 10 is 650.
e. 271 rounded to the nearest 10 is 270.
f. 587 rounded to the nearest 10 is 590.

Now practise rounding to the nearest 100. The rule is exactly the same.

2. Round these numbers to the nearest 100:
   b. 325
   c. 350
   d. 365
   e. 2 924
   f. 1 630
   g. 2 279

Check with our suggestions before continuing.

Answer

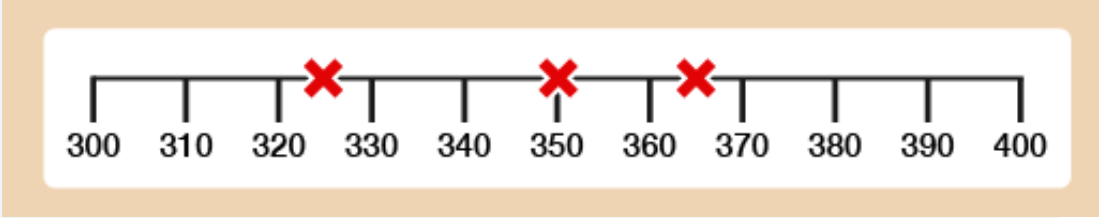


Figure 6 A number line

You can see in Figure 6 that:

a. 325 rounded to the nearest 100 is 300.
b. 350 rounded to the nearest 100 is 400.
c. 365 rounded to the nearest 100 is 400.

The other answers are as follows:

d. 2 924 rounded to the nearest 100 is 2 900.
e. 1 630 rounded to the nearest 100 is 1 600.
f. 2 279 rounded to the nearest 100 is 2 300.

Now practise rounding to the nearest 1 000.

3. Round these numbers to the nearest 1 000:
   c. 4 250
   d. 4 650
   e. 4 500
   f. 4 060
   g. 31 300
   h. 13 781
   i. 155 600

Answer

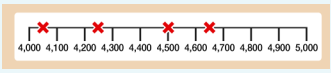


Figure 7 A number line

You can see in Figure 7 that:

a. 4 250 rounded to the nearest 1 000 is 4 000.
b. 4 650 rounded to the nearest 1 000 is 5 000.
c. 4 500 rounded to the nearest 1 000 is 5 000.
d. 4 060 rounded to the nearest 1 000 is 4 000.

The other answers are as follows:

e. 31 300 rounded to the nearest 1 000 is 31 000.
f. 13 781 rounded to the nearest 1 000 is 14 000.
g. 155 600 rounded to the nearest 1 000 is 156 000.

We often round numbers in real life especially when shopping. Watch the video on the BBC Skillswise website to learn more about real-life examples of rounding.

Rounding to the nearest £

The rule is that if the amount ends in 50p or more, round up to the £ above, and if the amount ends in less than 50p, the £ stays the same.

For example:

£6.32 = £6 to the nearest £ (because 32p is less than 50p)

£42.51 = £43 to the nearest £ (because 51p is more than 50p)

Activity 16: Rounding to the nearest £

Round the following amounts to the nearest £:

1. £5.20
2. £1.70
3. £7.35
4. £13.13
5. £23.51
6. £128.85

Answer

1. £5
2. £2
3. £7
4. £13
5. £24
6. £129

Activity 17: Bill's shopping

1. Bill has £20 to spend on his shopping. Here's a list of the items he selects, along with how much they cost:

Figure 8 A shopping list

Use your rounding skills to work out whether Bill has enough money to pay for all of his shopping.

Hint: In this activity you should round to the nearest pound, so £2.20 would be rounded to £2.

Answer

Rounding all of the items should give you a total of £19 – so yes, Bill probably has enough money to pay for all of his shopping.

2. Can you total all of the items on the shopping list to see what the actual cost of Bill's shopping is?

Answer

The total cost of all of the items on the shopping list comes to £19.33, which is very close to the answer you achieved through rounding.

Well done! You have now successfully rounded and carried out some basic number work. Can you see the importance of rounding? This is especially important when sticking to a budget.

2.1 Estimating answers to calculations

Throughout this course you will be asked to estimate or approximate an answer in a scenario. If you do not use rounding to provide an answer to this question your answer will be incorrect.

Try the following activity using rounding throughout. Pay particular attention to the language used.

Activity 18: Rounding

1. The population of a city is 6 439 800. Round this number to the nearest million.
2. Tickets to a concert cost £6 each. 6 987 tickets have been sold. Approximately how much money has been collected?
3. 412 students passed their Maths GCSE this year at Longfield High School. 395 passed last year. Approximately how many students passed GCSE Maths over the last two years?
4. Four armchairs cost £595. What is the approximate cost of one armchair?

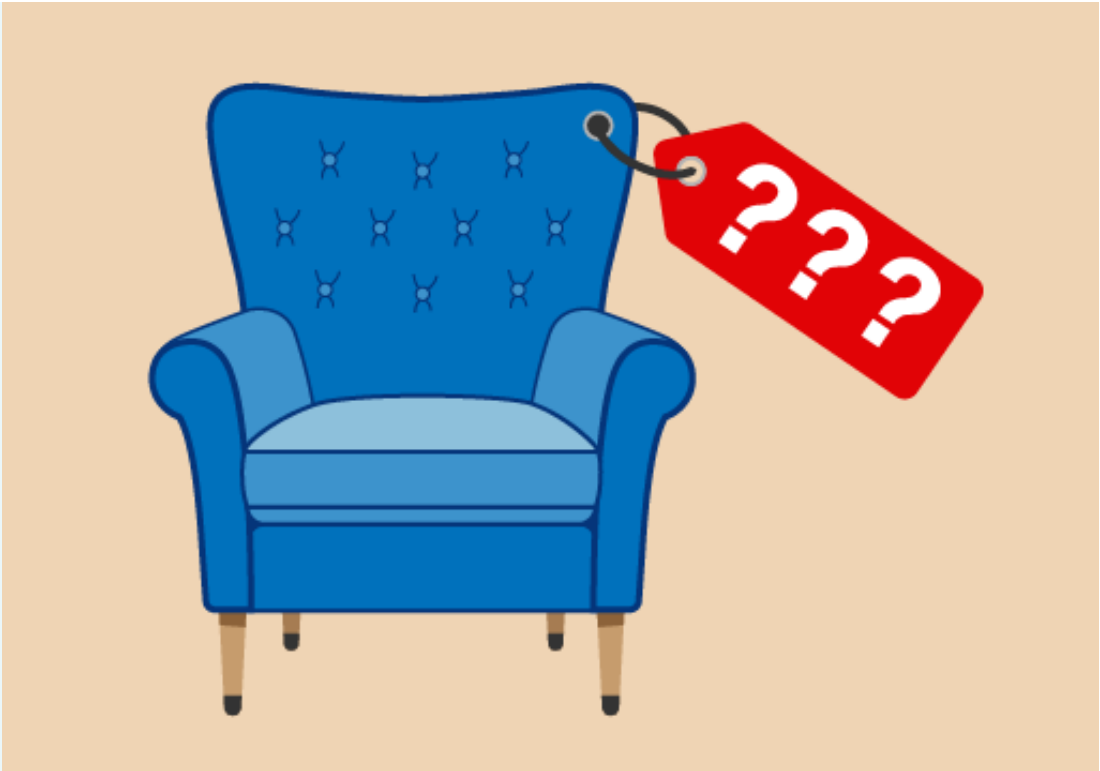


Figure 9 How much for one armchair?

5. A box contains 18 pencils. A company orders 50 boxes. Approximately how many pencils is that?
6. A teacher is buying packs of markers for her classroom. Each pack contains 12 markers. If she has 29 students in her class and wants to give each student one marker, how many packs of markers should she buy?

Answer

1. The population rounds to 6 000 000 (six million). This is because 6 439 800 is nearer to 6 million than 7 million.
2. 6 987 rounded to the nearest 1 000 is 7 000. If each ticket costs £6, the approximate total amount of money collected is:

   £6 × 7 000 = £42 000
3. 412 to the nearest hundred is 400. 395 to the nearest hundred is also 400. So the total approximate number of students passing GCSE Maths is:

   400 + 400 = 800 students
4. £595 to the nearest hundred is £600. So the approximate cost of one armchair is:

   £600 ÷ 4 = £150
5. 18 rounded to the nearest 10 is 20. So the approximate total number of pencils is:

   20 × 50 = 1 000 pencils

   Note: 50 × 20 = 50 × 2 × 10 = 100 × 10 = 1 000.
6. She needs 29 markers for her students. As she can only buy in multiples of 12, she would need to round 29 to the nearest multiple of 12 without going under.
   - 2 × 12 = 24 markers (this is not enough)

• 3 × 12 = 36 markers.

Therefore, she must buy 3 packs of markers for her class. She will have 7 left over.

Summary

So far you have worked with negative numbers, whole numbers, estimation, multiples and square numbers. All of the practised skills will help you with everyday tasks such as shopping, working with a budget and reading temperatures. The objectives that you have covered are:

- the meaning of a positive and negative number
- how to carry out calculations with whole numbers
- how an approximate answer can help to check an exact answer
- multiples and square numbers.

Later in this course you will be looking at inverse calculations. This means reversing all operations to check that your answer is correct.

3 Fractions

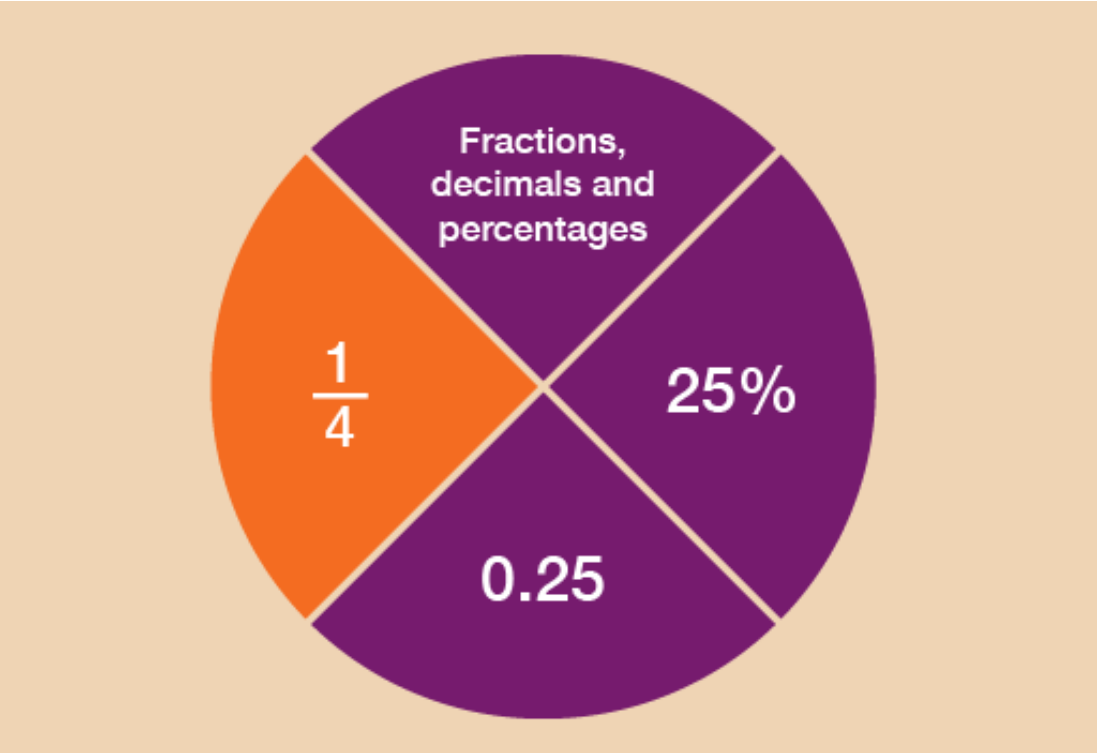


Figure 10 Looking at fractions

What is a fraction?

A fraction is defined as a part of a whole. So for example $\frac{1}{3}$, or 'one third', is one part of three parts, all of equal size.

Figure 11 Presenting a fraction: one third

Fractions are an important feature of everyday life. They could ensure that you get the best deal when shopping – or that you receive the largest slice of pizza! As you go through this section, you'll see how fractions could be used when you are shopping or within the workplace.

Fractions are related to decimals and percentages, which you'll look at in the sections that follow this one.

This section will help you to:

- order and compare fractions
- identify equivalencies between fractions
- calculate parts of whole quantities and measurements (e.g. calculate discounts in sales).

Please look at the following example before you carry out the activity:

A **half** can be written as $\frac{1}{2}$, i.e. one of two equal parts.

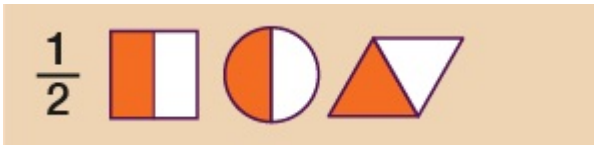


Figure 12 Presenting a fraction: one half

A **quarter** can be written as $\frac{1}{4}$, i.e. one of four equal parts.

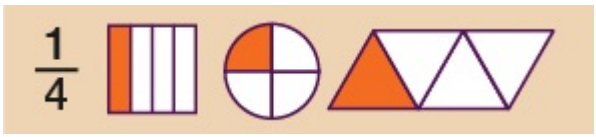


Figure 13 Presenting a fraction: one quarter

An **eighth** can be written as $\frac{1}{8}$, i.e. one of eight equal parts.

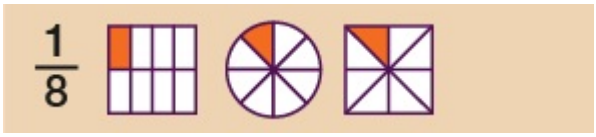


Figure 14 Presenting a fraction: one eighth

Hint: The top of the fraction is called the numerator. The bottom of the fraction is called the denominator. Any fraction with a 1 on the top is called a 'unit fraction', so $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{12}$, for example, are all unit fractions.

A fraction may not have a 1 on the top. For example, $\frac{2}{3}$ means 'two out of three parts', or 'two thirds'.

Figure 15 Presenting a fraction: two thirds

Example: Where there's a will, there's a fraction

Lord Walton draws up a will to decide who will inherit the family estate. He proposes to leave $\frac{1}{2}$ of the estate to his son, $\frac{1}{3}$ to his daughter and $\frac{1}{6}$ to his brother.

1. Who gets the biggest share?
2. Who gets the smallest share?

Method

When numerators of fractions are all 1, the larger the denominator of the fraction, the smaller the fraction.

Looking at the example above, the fractions can be put in order of size starting from the smallest:

$\frac{1}{6}, \frac{1}{3}, \frac{1}{2}$

So:

1. The biggest share ($\frac{1}{2}$) goes to his son.
2. The smallest share ($\frac{1}{6}$) goes to his brother.

If you're asked to arrange a group of fractions into size order, it's sometimes helpful to change the denominators to the same number. This can be done by looking for the lowest common multiple – that is, the number that all of the denominators are multiples of.

3.1 Using equivalent fractions

Equivalent fractions are fractions that are the same as each other, but are expressed in different ways. The BBC Skillswise website has an explanation of equivalent fractions.

To make an equivalent fraction, you multiply or divide the numerator (top) and denominator (bottom) by the same number. The size of the fraction is not altered. For example:

In the fraction $\frac{4}{6}$, the numerator is 4 and the denominator is 6.

4 × 2 = 8

6 × 2 = 12

So $\frac{4}{6} = \frac{8}{12}$

In the fraction $\frac{10}{15}$, the numerator is 10 and the denominator is 15.

10 ÷ 5 = 2

15 ÷ 5 = 3

So $\frac{10}{15} = \frac{2}{3}$

Example: Looking at equivalent fractions

Arrange the following fractions in order of size, starting with the smallest:

$\frac{3}{6}, \frac{1}{3}, \frac{2}{12}$

Method

You need to look at the bottom number in each fraction (the denominator) and find the lowest common multiple. In this case, the bottom numbers are 6, 3 and 12, so the lowest common multiple is 12:

6 × 2 = 12
3 × 4 = 12
12 × 1 = 12

Whatever you do to the bottom of the fraction you must also do to the top of the fraction, so that it holds the equivalent value. The third fraction, $\frac{2}{12}$, already has 12 as its denominator, so we don't need to make any further calculations for this fraction. But what about $\frac{3}{6}$ and $\frac{1}{3}$?

2 × $\frac{3}{6}$ means calculating (2 × 3 = 6) and (2 × 6 = 12), so the equivalent fraction is $\frac{6}{12}$

4 × $\frac{1}{3}$ means calculating (4 × 1 = 4) and (4 × 3 = 12), so the equivalent fraction is $\frac{4}{12}$

Now you can now see the size order of the fractions clearly:

$\frac{2}{12}, \frac{4}{12}, \frac{6}{12}$

So the answer is:

$\frac{2}{12}, \frac{1}{3}, \frac{3}{6}$

Use the examples above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 19: Fractions in order of size

1. Put these fractions in order of size, with the smallest first:

   $\frac{1}{5}, \frac{1}{3}, \frac{1}{4}, \frac{1}{10}, \frac{1}{2}$

Answer

Remember that when the numerator of a fraction is 1, the larger the denominator, the smaller the fraction.

From smallest to largest, the order is:

$\frac{1}{10}, \frac{1}{5}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}$

2. What should you replace the question marks with to make these fractions equivalent?

$\frac{1}{3} = \frac{?}{6}$

$\frac{1}{4} = \frac{?}{8}$

$\frac{1}{5} = \frac{?}{10}$

$\frac{1}{2} = \frac{?}{10}$

Answer

$\frac{1}{3} = \frac{2}{6}$

$\frac{1}{4} = \frac{2}{8}$

$\frac{1}{5} = \frac{2}{10}$

$\frac{1}{2} = \frac{5}{10}$

3. Put these fractions in order of size, with the smallest first:

$\frac{2}{3}, \frac{3}{5}, \frac{3}{10}$

Answer

You need to change to equivalent fractions to compare like-for-like. To do this, you need to look at the bottom numbers of the fractions (3, 5 and 10) and find the lowest common multiple. The lowest common multiple of 3, 5 and 10 is 30:

3 × 10 = 30

5 × 6 = 30

10 × 3 = 30

Whatever you do to the bottom of each fraction, you must also do to the top:

With $\frac{2}{3}$, you need to multiply the top and bottom numbers by 10 to make $\frac{20}{30}$.

With $\frac{3}{5}$, you need to multiply the top and bottom number by 6 to equal $\frac{18}{30}$.

With $\frac{3}{10}$, you need to multiply the top and bottom number by 3 to equal $\frac{9}{30}$.

The order of the fractions from smallest to largest is therefore:

$\frac{3}{10}$ ($\frac{9}{30}$)

$\frac{3}{5}$ ($\frac{18}{30}$)

$\frac{2}{3}$ ($\frac{20}{30}$)

3.2 Drawing fractions

Example: Drawing the fractions

If you need to compare one fraction with another, it can be useful to draw the fractional parts.

Look at the mixed numbers below. (A mixed number combines a whole number and a fraction.) Say you wanted to put these amounts in order of size, with the smallest first:

$2\ \frac{1}{2}$, $3\ \frac{1}{4}$, $1\ \frac{1}{3}$

Method

To answer this you could look at the whole numbers first and then the fractional parts. If you were to draw these, they could look like this:

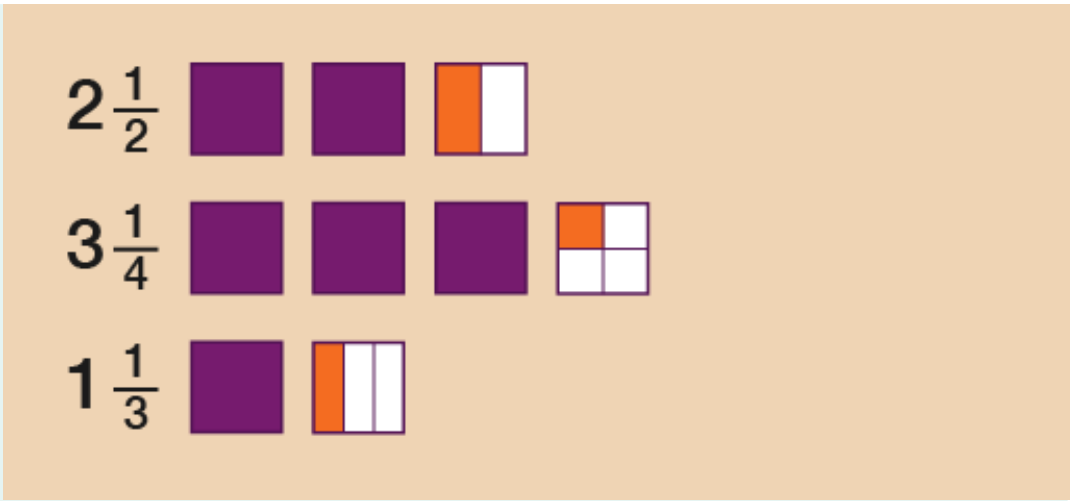


Figure 16 Drawing the fractions

So the correct order would be:

$1\ \frac{1}{3}$, $2\ \frac{1}{2}$, $3\ \frac{1}{4}$

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 20: Putting fractions in order

1. Put these fractions in order of size, smallest first:

   $5\ \frac{1}{4}$, $6\ \frac{1}{5}$, $2\ \frac{1}{2}$

2. Put these fractions in order of size, smallest first:

   $2\ \frac{2}{5}$, $1\ \frac{9}{10}$, $2\ \frac{1}{2}$

Answer

1. The correct order would be:

   $2\ \frac{1}{2}$, $5\ \frac{1}{4}$, $6\ \frac{1}{5}$

   In this case, even though $\frac{1}{2}$ is bigger than $\frac{1}{4}$ and $\frac{1}{4}$ is bigger than $\frac{1}{5}$, you need to look at the whole numbers first and then the fractions. The diagram illustrates this more clearly:

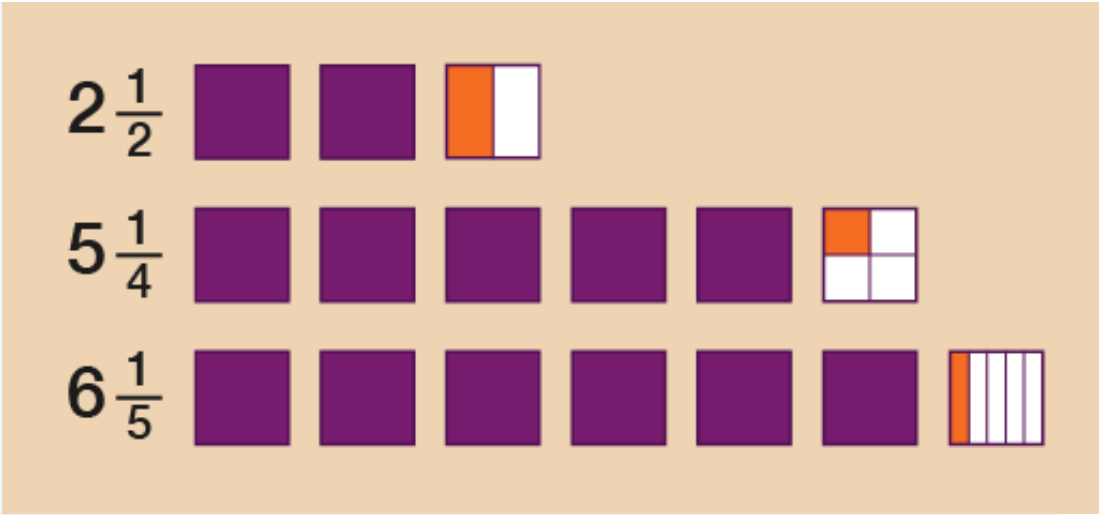


Figure 17 Drawing the fractions

2. The correct order would be:

   1 $\frac{9}{10}$, 2 $\frac{2}{5}$, 2 $\frac{1}{2}$

   Looking at the whole numbers, 1 $\frac{9}{10}$ would be the smallest because the other two mixed numbers are both greater than 2. To see which is bigger out of 2 $\frac{2}{5}$ or 2 $\frac{1}{2}$, you need to compare the fraction part. Which is bigger: $\frac{2}{5}$ or $\frac{1}{2}$?

   To work this out, you could draw images as above, or you could use the method we looked at earlier where you change to equivalent fractions – the bottom numbers of the fractions are 5 and 2, and the lowest common multiple of 5 and 2 is 10:
   5 × 2 = 10
   2 × 5 = 10
   Whatever you do to the bottom, do to the top:
   If you mulitiply the top and bottom numbers in $\frac{2}{5}$ by 2, you make $\frac{4}{10}$.

   If you mulitiply the top and bottom numbers in $\frac{1}{2}$ by 5, you make $\frac{5}{10}$.

   $\frac{4}{10}$ ($\frac{2}{5}$) is smaller than $\frac{5}{10}$ ($\frac{1}{2}$), so $2\frac{2}{5}$ is smaller than $2\frac{1}{2}$.

3.3 Simplifying fractions

You may need to simplify a fraction. The following terms may also be used for this:

- cancelling
- express in the lowest terms
- express in the simplest form.

For example, $\frac{8}{12}$ is equivalent to (the same as) $\frac{2}{3}$, which is the simplest way of writing this fraction.

Example: Simplifying fractions

1. Simplify $\frac{5}{20}$.
2. Simplify $\frac{20}{30}$.

Method

To simplify a fraction, you need to divide the top and bottom numbers by the same value. You keep dividing down until you cannot get the fraction any smaller. Each time you divide, you must divide the top and bottom numbers by the same value.

1. In order to simplify $\frac{5}{20}$, you need to find out what number will divide into 5 and 20. The only number that will divide into both 5 and 20 is 5:

   5 ÷ 5 = 1
   20 ÷ 5 = 4

   So $\frac{5}{20} = \frac{1}{4}$.

2. There are different ways to simplify $\frac{20}{30}$ to the lowest form. For example, you can divide both numbers in $\frac{20}{30}$ by 2:

   20 ÷ 2 = 10
   30 ÷ 2 = 15

   However, $\frac{10}{15}$ not the simplest form of the fraction. You can simplify the fraction further by dividing the top and bottom numbers by 5:

   10 ÷ 5 = 2
   15 ÷ 5 = 3

   $\frac{2}{3}$ is the simplest form of $\frac{20}{30}$.

   However, you may have recognised that 10 will go into both 20 and 30, so you may have divided by 10 straightaway:

   20 ÷ 10 = 2
   30 ÷ 10 = 3

   The answer is the same, but dividing by 10 would have got you to the answer more quickly.

Now try the following activity.

Activity 21: Simplifying fractions

Simplify the following fractions:

1. $\frac{5}{10}$
2. $\frac{20}{25}$
3. $\frac{3}{6}$
4. $\frac{2}{8}$
5. $\frac{3}{9}$

Answer

1. $\frac{5}{10} = \frac{1}{2}$ (the top and bottom numbers are divided by 5)
2. $\frac{20}{25} = \frac{4}{5}$ (the top and bottom numbers are divided by 5)
3. $\frac{3}{6} = \frac{1}{2}$ (the top and bottom numbers are divided 2)
4. $\frac{2}{8} = \frac{1}{4}$ (the top and bottom numbers are divided 2)
5. $\frac{3}{9} = \frac{1}{3}$ (the top and bottom numbers are divided 3)

3.4 Fractions of amounts

Have a look at the following examples, which demonstrate how you would find the fraction of an amount.

Figure 18 a shop sale.

Say you go into a shop to buy a dress. Usually it would cost £90, but today it's in the '$\frac{1}{3}$ off' sale. How much would you get off?

Method

The basic rule for finding a unit fraction of an amount is to divide by how many parts there are (the number on the bottom of the fraction) and multiply the result by the number at the top of the fraction.

To work out $\frac{1}{3}$ off £90 is the same as:

£90 ÷ 3 = £30

The sum £30 × 1 = £30, so you would get £30 off.

Survey

In a survey, $\frac{3}{4}$ of respondents said that they would like to keep the pound as the currency of the UK. If 800 people were surveyed, how many people wanted to keep the pound?

Method

Again, to find a fraction of an amount you need to divide by the number at the bottom of the fraction and then multiply that result by the number at the top of the fraction:

To answer this you need to first work out what $\frac{1}{4}$ of 800 people is.

$\frac{1}{4}$ of 800 = 800 ÷ 4 = 200

Then use the numerator (the top of the fraction) to work out how many of those unit fractions are needed:

$\frac{3}{4}$ of 800 = 3 × 200 = 600

So 600 people wanted to keep the pound.

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 22: Paying in instalments

Figure 19 How much would an extension cost?

A family plans to have its kitchen extended.

The cost of this project is £12 000.

The builder they have chosen to carry out this job has asked for the money to be paid in stages:

1. $\frac{1}{5}$ of the money to be paid before starting the project.
2. $\frac{2}{3}$ of the money to be paid a month later.
3. The remainder to be paid when the extension has been built.

How much is the builder asking for during Stage 1 and Stage 2?

Answer

To work out $\frac{1}{5}$ of £12 000 you need to divide £12 000 by 5.

12 000 ÷ 5 = 2 400

Now multiply by the number on the top of the fraction:

2 400 × 1 = £2 400

So at Stage 1 the builder will need £2 400.

To work out $\frac{2}{3}$ of £12 000 you need to first work out $\frac{1}{3}$ of £12 000. To do this you need to divide £12 000 by 3.

12 000 ÷ 3 = 4 000

You now need to work out $\frac{2}{3}$ of £12 000 so you multiply by the number on the top of the fraction:

4 000 × 2 = 8 000

So at Stage 2 the builder will need £8 000.

Summary

In this section you have learned how to:

- find equivalencies in fractions
- order and compare fractions
- find the fraction of an amount.

The skills listed above can be used when you are shopping and trying to get the best deal, or when you are splitting a cake or a pizza, say, into equal parts.

It's important to be able to compare fractions, decimals and percentages in real-life situations. You'll be looking at percentages later, but first you can look at decimals.

4 Decimals

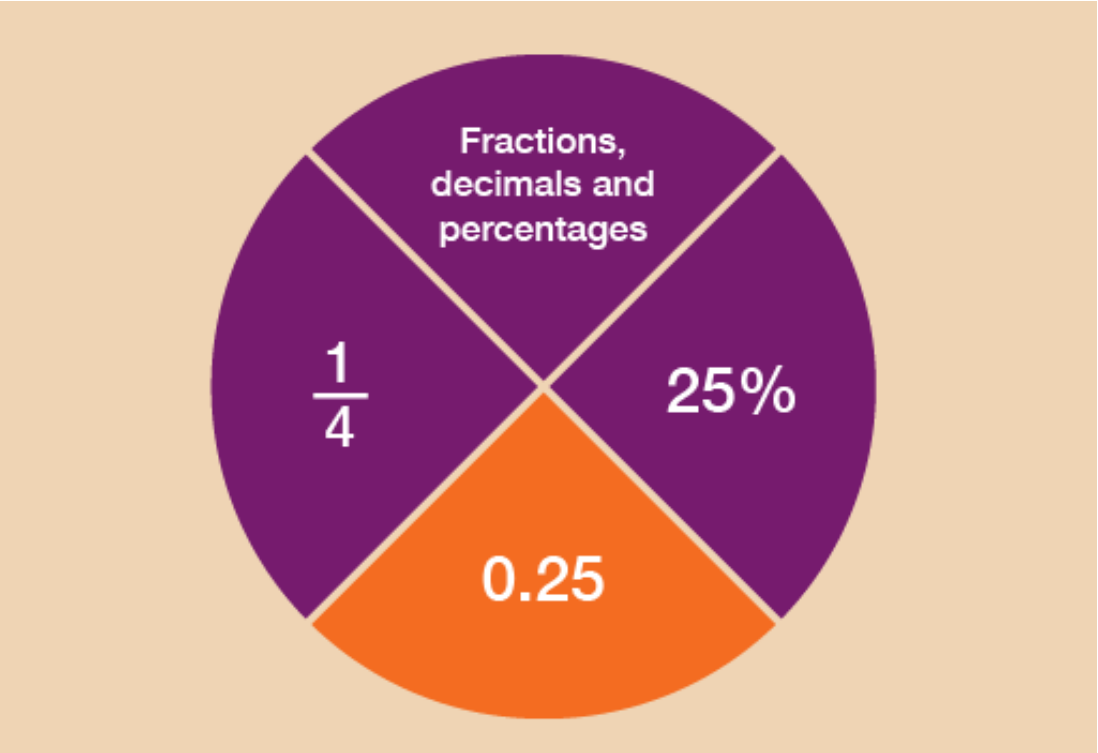


Figure 20 Looking at decimals

Can you think of any examples of when you might come across decimal numbers in everyday life?

If you're dealing with money and the decimal point is not placed correctly, then the value will be completely different, for example, £5.55 could be mistaken for £55.50.

Likewise with weights and measures: if the builder in the last activity made a wrong measurement, the whole kitchen extension could be affected.

This section will help you to understand:

- the value of a digit in a decimal number
- ways of carrying out calculations with decimal numbers
- approximate answers to calculations involving decimal numbers.

You looked at place value in the section on whole numbers. Now you'll take a look at decimals.

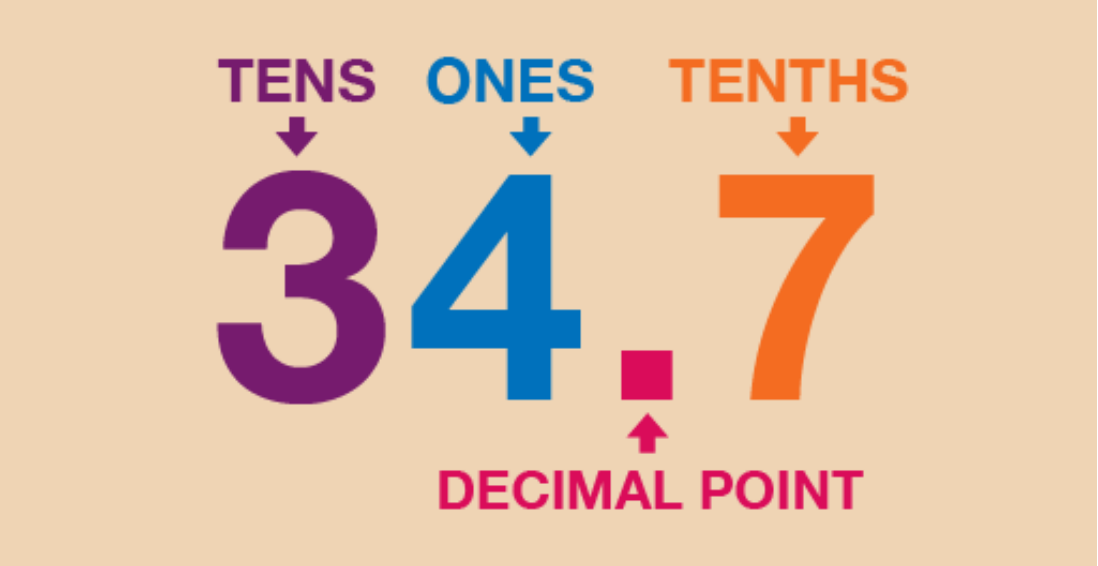


Figure 21 What is a decimal point?

So what is a decimal point?

It separates a number into its whole number and its fractional part. So in the example above, 34 is the whole number, and the seven – or 0.7, as it would be written – is the fractional part.

Each digit in a number has a value that depends on its position in the number. This is its place value:

Whole number part					**Fractional part**		
Thousands	**Hundreds**	**Tens**	**Units**	.	**Tenths**	**Hundredths**	**Thousandths**
1000s	100s	10s	1s	.	$\frac{1}{10}$s	$\frac{1}{100}$s	$\frac{1}{1,000}$s

Look at these examples, where the number after the decimal point is also shown as a fraction:

5.1 = 5 and $\frac{1}{10}$

67.2 = 67 and $\frac{2}{10}$

8.01 = 8 and $\frac{1}{100}$

Example: Finding values

If you were looking for the place value of each digit in the number 451.963, what would the answer be?

Hundreds	Tens	Units	.	Tenths	Hundredths	Thousandths
4	5	1	.	9	6	3

So the answer is:

4 hundreds

5 tens

1 unit

9 tenths ($\frac{9}{10}$)

6 hundredths ($\frac{6}{100}$)

3 thousandths ($\frac{3}{1\ 000}$)

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 23: Decimal dilemmas

1. Four children are taken to the funfair. One of the rides, the Wacky Wheel, has the following notice on it:

   For safety reasons, children must be over 0.95 m tall to go on this ride.

   Margaret is 0.85 m tall.
   David is 0.99 m tall.
   Suha is 0.89 m tall.
   Prabha is 0.92 m tall.
   Who is allowed to go on the ride?

2. Six athletes run a race. Their times, in seconds, are as follows:

Sonia	10.95
Anjali	10.59
Anita	10.91
Aarti	10.99
Sita	10.58
Susie	10.56

   Who gets the gold, silver and bronze medals?

3. In a gymnastics competition, the following points were awarded to four competitors. Who came first, second and third?

Janak	23.95
Nadia	23.89
Carol	23.98
Tracey	23.88

Answer

1. Any child that is more than 0.95 m tall will be allowed on the ride. So to answer the question you need to compare the height of each child with 0.95 m.

	Tenths	Hundredths
Margaret	8	5
David	9	9
Suha	8	9
Prabha	9	2

Comparing the tenths tells us that only two children may possibly be allowed on the ride: David and Prabha.
If we go on to compare the hundredths, we see that only David is taller than 0.95 m.
So only David would be allowed on the Wacky Wheel.

2. You need to compare the tens, units, tenths and hundredths, in that order.

	Tens	Units	.	Tenths	Hundredths
Sonia	1	0	.	9	5
Anjali	1	0	.	5	9
Anita	1	0	.	9	1
Aarti	1	0	.	9	9
Sita	1	0	.	5	8
Susie	1	0	.	5	6

All of the times have the same number of tens and units, so it is necessary to go on to compare the tenths.

The three times with the lowest number of tenths are 10.59, (Anjali), 10.58 (Sita) and 10.56 (Susie). If we now go on to compare the hundredths in these three times, we see that the lowest times are (lowest first): 10.56, 10.58 and 10.59.
So medals go to:

Susie (10.56 secs): gold
Sita (10.58 secs): silver
Anjali (10.59 secs): bronze

3. Again, we need to compare the tens, units, tenths and hundredths, in that order.

	Tens	Units	.	Tenths	Hundredths
Janak	2	3	.	9	5
Nadia	2	3	.	8	9
Carol	2	3	.	9	8
Tracey	2	3	.	8	8

All the scores have the same number of tens and units. Looking at the tenths, two scores (23.95 and 23.98) have 9 tenths. If you compare the hundredths in these two numbers, you can see that 23.98 is bigger than 23.95.
To find the third highest number, go back to the other two numbers, 23.89 and 23.88. Comparing the hundredths, you can see that 23.89 is the higher number. So the top three competitors are:

Carol (23.98)
Janak (23.95)
Nadia (23.89)

4.1 Approximations with decimals

Now you have looked at the place value system for decimals, can you use your rounding skills to estimate calculations using decimals? This skill would be needed in everyday life to approximate the cost of your shopping.

Example: Approximations with decimals

Give approximate answers to these. Round each decimal number to the nearest whole number before you calculate.

1. 2.7 + 9.1
2. 9.6 cm – 2.3 cm
3. 2.8 g × 2.6 g
4. 9.6 ml × 9.5 ml

Method

1. 2.7 lies between 2 and 3, and is nearer to 3 than 2.

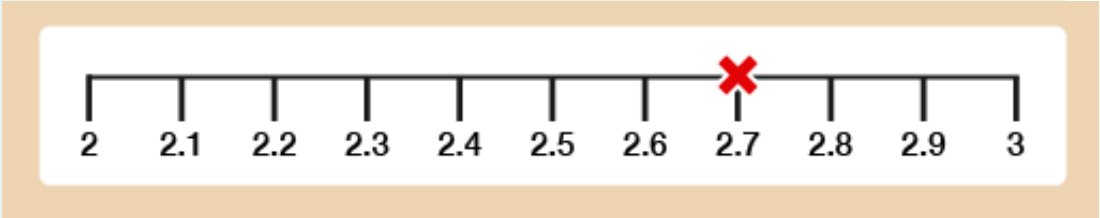


Figure 22 A number line

9.1 lies between 9 and 10, and is nearer to 9 than 10.

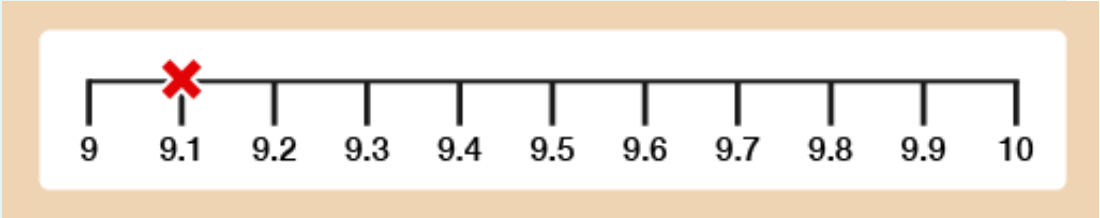


Figure 23 A number line

So our approximate answer is:

3 + 9 = 12

2. Similarly, 9.6 cm lies between 9 cm and 10 cm and is nearer to 10 cm than 9 cm, and 2.3 cm is nearer to 2 cm than 3 cm. So our approximate answer is:

   10 cm – 2 cm = 8 cm

3. 2.8 g is nearer to 3 g than 2 g, and 2.6 g is also nearer to 3 g than 2 g. So our approximate answer is:

   3 g × 3 g = 9 g

4. 9.6 ml is nearer to 10 ml than 9 ml. 9.5 ml is exactly halfway between 9 ml and 10 ml. When this happens we always round up, meaning that 9.5 ml is rounded up to 10 ml. So our approximate answer is:

   10 ml × 10 ml = 100 ml

Example: Rounding to two decimal places

You may be asked to round a number to two decimal places. All this means is if you are faced with lots of numbers after the decimal point, you will be asked to only leave two numbers after the decimal point. This is useful when a calculator gives us lots of decimal places.

1. Round 3.426 correct to two decimal places (we want two digits after the decimal point).

Method

Look at the third digit after the decimal point.

If it is 5 or more, round the previous digit up by 1. If it is less than 5, leave the previous digit unchanged.

The third digit after the decimal point in 3.426 is 6. This is more than 5, so you should round up the previous digit, 2, to 3.

So the answer is 3.43.

2. Round 2.8529 to two decimal places.

Method

As in part (a) above, the question is asking you to round to two digits after the decimal point.

Look again at the third digit after the decimal point.

This is 2 (less than 5) so we leave the previous digit (5) unchanged.

The answer is 2.85.

3. Round 1.685 to two decimal places.

Here, the third digit after the decimal point is 5, which means the previous digit (8) needs to be rounded up.

The answer is 1.69.

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Hint: 'Five or more, raise the score!'

Activity 24: Rounding

1. Work out approximate answers to these by rounding each decimal number to the nearest whole number:
   a. 3.72 + 8.4
   b. 9.6 – 1.312
   c. 2.8 × 3.4
   d. 9.51 ÷ 1.5
2. Round the following numbers to two decimal places:
   a. 3.846
   b. 2.981
   c. 3.475

Answer

1. The answers are as follows:
   a. The nearest whole number to 3.72 is 4.
   The nearest whole number to 8.4 is 8.
   So our approximate answer is:

4 + 8 = 12

b. The nearest whole number to 9.6 is 10.

The nearest whole number to 1.312 is 1.

So our approximate answer is:

10 – 1 = 9

c. The nearest whole number to 2.8 is 3.

The nearest whole number to 3.4 is 3.

So our approximate answer is:

3 × 3 = 9

d. The nearest whole number to 9.51 is 10.

The nearest whole number to 1.5 is 2.

So our approximate answer is:

10 ÷ 2 = 5

2. The answers are as follows:

a. To round to two decimal places, look at the third digit after the decimal point. This is more than 5, so round the previous digit (4) up to 5.

The answer is 3.85.

b. In this case, the third digit after the decimal point is less than 5, so leave the previous digit unchanged.

The answer is 2.98.

c. The third digit after the decimal point here is 5. Remember in this case we always round up.

The answer is 3.48.

4.2 Rounding money

Rounding money to the nearest 10p

We use rounding with money in real life when shopping on a budget or maybe checking a bill.

The rule is that if the amount ends in 5p or more, you round up to the next 10p above, and if the amount ends in less than 5p, the 10p digit remains unchanged. For example:

43p ends in 3 (it's less than 5) so it can be rounded down to 40p

78p ends in 8 (it's more than 5) so it can be rounded up to 80p

Activity 25: Rounding to the nearest 10p

Round the following amounts to the nearest 10p:

1. 13p
2. 26p
3. 35p

4. £4.72
5. £8.63
6. £14.85

Answer

1. 10p
2. 30p
3. 40p
4. £4.70
5. £8.60
6. £14.90

Rounding money to the nearest £

When rounding to the nearest £, the rule is that if the amount ends in 50p or more, round up to the £ above, and if the amount ends in less than 50p, the pound column remains unchanged. For example:

£3.42 ends in 42 (it's less than 50) so it can be rounded down to £3

£56. 67 ends in 67 (it's more than 50) so it can be rounded up to £57

Activity 26: Rounding to the nearest £

Round the following amounts to the nearest £:

1. £6.30
2. £9.70
3. £0.50
4. £13.12
5. £26.17
6. £52.50

Answer

1. £6
2. £10
3. £1
4. £13
5. £26
6. £53

Summary

By completing this topic you have learned how to approximate answers to calculations involving decimal numbers.

You have also learned how to round a decimal number to two decimal places and round money to the nearest 10p or £.

4.3 Calculations using decimals

When you make any calculation with decimals – that is, addition, subtraction, multiplication and division – it is very important to make sure that the decimal point is in the correct place. If you don't, you'll get the wrong answer.

Addingand subtracting decimals

Whenwe add or subtract decimals, it is important to line up the decimalpoints.

Calculatethe following:

1. 14.08 + 4.1

2. 34.45 – 2.3

Method

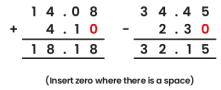


Figure 24 Calculating using decimals

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 27: Using decimals

Now try the following activity using written methods. Remember to check your answers once you have completed the questions.

1. 4.2 + 3.7
2. 6.7 – 5.1
3. 42.19 + 13.5
4. 74.8 – 24.3
5. £163.25 + £27.12
6. 2.1 m – 0.75 m

Answer

1. 7.9
2. 1.6
3. 55.69
4. 50.5
5. £190.37
6. 1.35 m

Multiplication

Multiplying decimals by 10, 100 and 1 000

When you multiply a decimal number by 10, all the numbers get 10 times bigger, so the decimal point moves one place to the right.

When you multiply by 100, all the numbers get 100 times bigger, so the decimal point moves two places to the right.

When you multiply by 1 000 all the numbers get 1 000 times bigger, so the decimal point moves three places to the right.

The following video shows you the correct method for multiplying decimal numbers by 10, 100 or 1 000:

View at: youtube:X1HgWTsccKI

Now try the following activity.

Activity 28: Multiplying decimals by 10, 100, 1000

Calculate the following:

1. 16.3 × 10
2. 5.27 × 10
3. 82.05 × 100
4. 673.2 × 100
5. 48.851 × 1 000
6. 59.24 × 1 000

Answer

1. 163
2. 52.7
3. 8 205
4. 67 320
5. 48 851
6. 59 240

Multiplying decimals

When multiplying decimal numbers, you should ignore the decimal point and use your usual method to multiply the numbers you are given.

When you have your answer, count up the total number of decimal places (or ‘dp’) in both of the numbers you have multiplied.

Starting from the right-hand column of your answer, count the same number of decimal places (dp) to the left and place your decimal point.

Watch the following video for an explanation of multiplying decimal numbers:

View at: youtube:YzdPPEqDpUI

Activity 29: Multiplying decimals

Complete this activity using the multiplication method you are most comfortable with.Show your answers to two decimal places (2 dp).

1. 0.7 × 4
2. 0.3 × 0.4
3. 18.7 × 3
4. 6.31 × 2.2
5. 1.9 × 0.59
6. 2.35 × 1.78
7. Teabags cost £1.29 a box. How much will five boxes cost?
8. Alun earns £8.95 an hour. How much does he earn for 37.5 hours?

Answer

1. 2.8
2. 0.12
3. 56.1
4. 13.882 (13.88 to 2 dp)
5. 1.121 (1.12 to 2 dp)
6. 4.183 (4.18 to 2 dp)
7. £6.45
8. £335.625 (£335.63 to 2 dp)

Division

Dividing decimals by 10, 100 and 1 000

When you divide a decimal number by 10, all the numbers get 10 times smaller, so the decimal point moves one place to the left.

When you divide by 100, all the numbers get 100 times smaller, so the decimal point moves two places to the left.

When you divide by 1 000, all the numbers get 1 000 times smaller, so the decimal point moves three places to the left.

Watch the following clip which will show you the correct method for dividing decimal numbers by 10, 100 or 1 000.

View at: youtube:WJldAeh27nw

Now try the following activity.

Activity 30: Dividing decimals by 10, 100, 1 000

Calculate the following:

1. 57.08 ÷ 10
2. 6.09 ÷ 10
3. 433.57 ÷ 100
4. 51.2 ÷ 100
5. 899.34 ÷ 1 000
6. 67.51 ÷ 1 000

Answer

1. 5.708
2. 0.609
3. 4.3357
4. 0.512
5. 0.89934
6. 0.06751

Dividing a decimal number by a whole number

When you divide a decimal number by a whole number, you divide as normal and keep the decimal point in line.

The following video includes some examples:

View at: youtube:6FHL3J3FYaE

Now try the following activity.

Activity 31: Dividing a decimal by a whole number

Calculate the following:

1. 8.46 ÷ 6
2. 79.9 ÷ 5
3. 70.38 ÷ 9

4. 423.06 ÷ 3
5. 0.845 ÷ 5
6. 301.14 ÷ 8
7. If an electricity bill costs £527.40 per year, how much does it cost per month?
8. A taxi bill costs £34.80. If this is shared by four friends, how much will each person pay?

Answer

1. 1.41
2. 15.98
3. 7.82
4. 141.02
5. 0.169
6. 37.6425
7. £43.95 per month
8. £8.70 each

Dividing a decimal number by another decimal number

When you divide a decimal number by another decimal number, you first have to change the number you are dividing by into a whole number. You do this by multiplying by either 10, 100 or 1 000.

Example: Dividing a decimal number by another decimal number

Calculate the following:

$$4.2625 \div 0.05$$

Method

The number you are dividing by is 0.05, so to make it a whole number you multiply by 100 (that is, move the decimal point two places to the right):

$$0.05 \times 100 = 5$$

You then multiply the number you are dividing into by the same amount, in this example 100. The number you are dividing into is 4.2625, so:

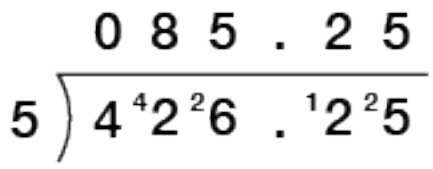
$$4.2625 \times 100 = 426.25$$

Note how you do not have to change the number that you are dividing into a whole number.

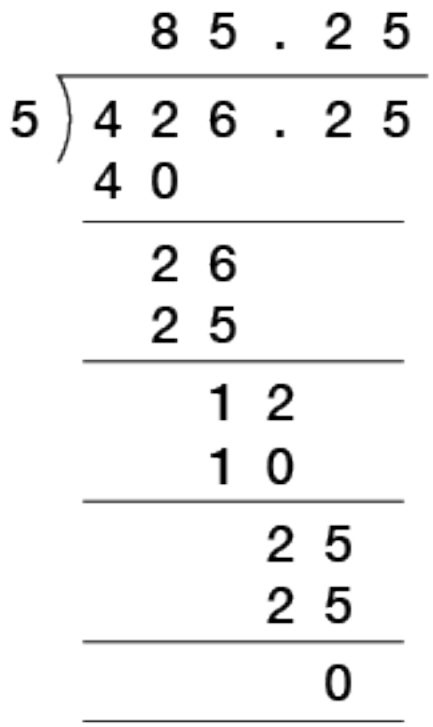
The calculation you now have is:

426.25 ÷ 5

Using the short division method, the calculation would be:



This could also be done using the long division method if this is the method you prefer to use:



However you do the division, just make sure the decimal point goes in line in the answer with where it is in the number you are dividing.

Now try the following activity.

Activity 32: Dividing a decimal by a decimal

Calculate the following, showing your answers to 2 dp when not exact:

1. 1.5 ÷ 0.5
2. 10.8 ÷ 0.03
3. 13.25 ÷ 0.5
4. 2.5 ÷ 0.04
5. 56.9 ÷ 3.1
6. 5.75 ÷ 1.1
7. If a tea urn holds 12.5 litres, how many 0.2 litre cups of tea will it provide?
8. A garden path is 9.5 metres long and paving slabs are 0.25 metres long each. How many paving slabs will it take to cover the length of the path?

Answer

1. 3
2. 360
3. 26.5
4. 62.5
5. 18.35 (to 2 dp)
6. 5.23 (to 2 dp)
7. 62.5 cups
8. 38 slabs

4.4 Decimal problems

Now try the following activity.

Activity 33: Using decimals

Figure 25 Using decimals

Solve these problems involving decimal numbers without using a calculator.

1. You buy a box of corn flakes for £2.65 and a bottle of milk for £1.98.
   a. What is the total cost of these items?
   b. You pay for them with a £5 note. How much change should you get?
2. You go on holiday to Italy. The rate of exchange is £1 = €1.4. How many euros do you get for £8?

3. You go out for a meal with three friends, and the total cost of the meal is £56.60. You decide to split the bill equally. How much does each of you pay?
4. Convert 6.25 m to cm. (Remember that 100 cm = 1 m.)

Answer

1. The answers are as follows:
   a. Add the cost of the two items:

$$\begin{array}{r} £2.65 \\ +\ £1.98 \\ \hline £4.63 \end{array}$$

   (Keep the decimal points in line.)
   The total cost of the items is £4.63.
   b. Take away the total cost from £5:

$$\begin{array}{r} £^{4}\cancel{5}.^{9}\cancel{0}\,^{1}0 \\ -\ £4.63 \\ \hline £0.37 \end{array}$$

   You should get 37p change from £5. You may have used a different method to work this out.
2. Multiply the exchange rate in euros (€1.4) by the amount in pounds (£8):

$$\begin{array}{r} 1.4 \\ \times\quad 8 \\ \hline 11.2 \end{array}$$

   So £8 = €11.20. You may have used a different method to work this out.
3. Divide the total cost (£56.60) by the number of people (4):

$$4\overline{)\,5\,^{1}6.6\,^{2}0}\quad 14.15$$

   You would each pay £14.15.
4. To convert 6.25 m into cm, you need to multiply the amount by 100.
   6.25 × 100 = 625
   So the answer is 625 cm.

Summary

In this section you have learned about how:

- the value of a digit depends on its position in a decimal number
- to approximate answers to calculations involving decimal numbers

- to add, subtract, multiply and divide using decimal numbers.

This will help when working with money and measurements.

5 Percentages

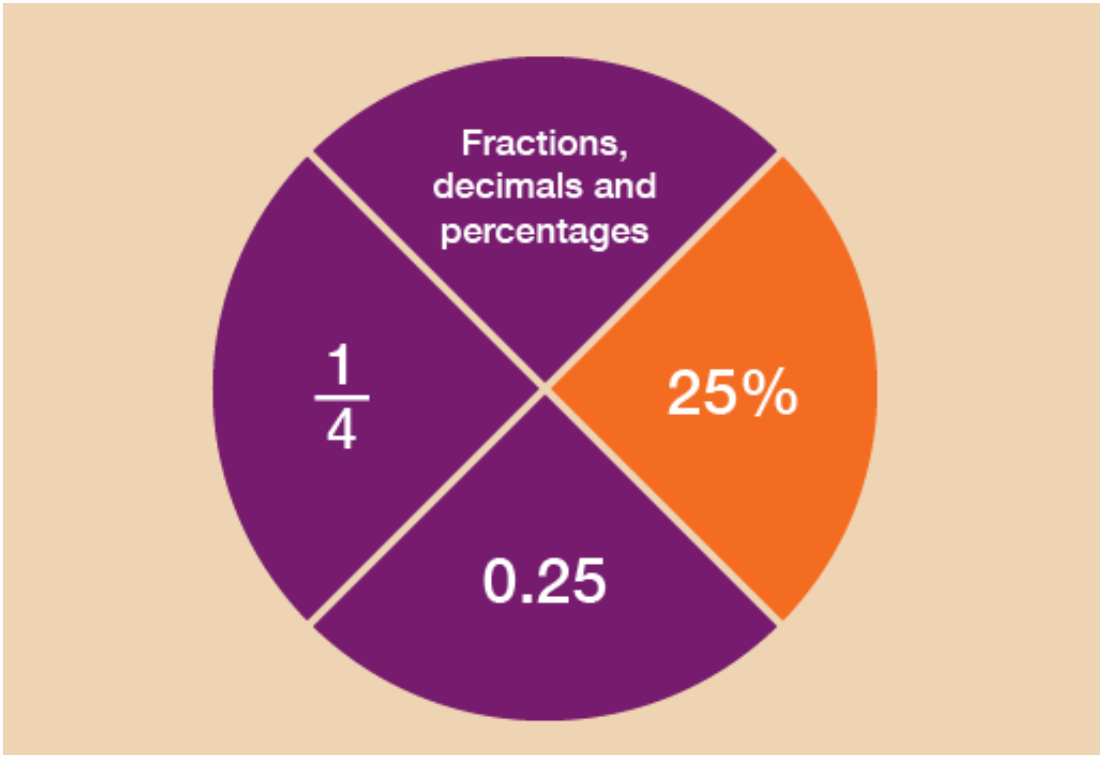


Figure 26 Looking at percentages

Like fractions and decimals, you'll see plenty of references to percentages in your everyday life. For example:

Figure 27 Examples of percentages

This section will help you to:

- order and compare percentages
- work out percentages in different ways
- understand how percentages increase and decrease
- recognise common equivalencies between percentages, fractions and decimals.

So what is a percentage?

- It's a number out of 100.
- 40% means '40 out of every 100'.
- The symbol for percentage is %.
- 100% means 100 out of 100. You could also say this as the fraction $\frac{100}{100}$.

You may have seen examples of percentages on clothes labels. ‘100% wool’ means that the garment is made entirely of wool and nothing else. ‘50% wool’ means that the garment is half made of wool, half made of other materials.

The following example shows how to work out a percentage of an amount.

Example: How can you calculate percentage reductions?

An online shop offers a 10% discount on a television that usually costs £400. How much discount do you get?

A percentage is a number out of 100, so 10% means ‘10 out of 100’. This could also be put as $\frac{10}{100}$, or 10 hundredths.

There are different ways that percentages can be worked out. The method that you choose really depends on the numbers that you are working with.

Here are two methods for solving this problem:

Method 1

We start with finding 1%.

To find 1% of an amount, divide by 100 (which you practised earlier in this session):

$400 \div 100 = 4$

Once we know 1% of an amount, we can find any percentage by multiplying by the percentage we want to find. So to find 10%, we multiply the 1% figure by 10:

$4 \times 10 = 40$

The discount is £40.

If you think of 10% as a large fraction, $\frac{10}{100}$, you use the rule of dividing by the denominator

(the bottom number in a fraction) and multiplying by the numerator (the top number).

There is an alternative method for finding the answer.

Method 2

A percentage is a number out of 100, so 10% is $\frac{10}{100}$, which is the same as saying $\frac{1}{10}$.

If we want to find out 10% of £400, that’s the same as finding out $\frac{1}{10}$ of £400:

$400 \div 10 = 40$

This gives us the answer £40.

If you can work out 10% of an amount, you can find lots of other percentages. Say, for example, you wanted to find 30% of £60.

First you find 10%, by dividing by 10 (method 2):

60 ÷ 10 = 6

30% is three lots of 10%, so once you know 10%, you multiply the amount by 3:

6 × 3 = 18

So 30% of £60 is £18.

Tips

- To find 20%, find 10% first and then multiply by 2.
- To find 5%, find 10% first and then halve the answer (divide by 2).

Which method do you prefer?

- Method 1 will work for any percentage and is a good method to use to find percentages using a calculator.
- Method 2 can be used to work out percentages in your head if the numbers are suitable.

There are some other quick ways of working out certain percentages:

50% = $\frac{1}{2}$, so you can halve the amount (divide the amount by 2)

25% = $\frac{1}{4}$, so you can divide the amount by 4 (or you can halve and halve again)

75% = $\frac{3}{4}$, so you can divide the amount by 4 and then multiply by 3 (or you can find

50% and 25% of the amount, and then add the two figures together).

Use whichever method you prefer to help you with the following activities. Remember to check your answers once you have completed the questions.

Activity 34: Finding percentages of amounts

1. You need to pay a 20% deposit on a holiday that costs £800. How much is the deposit?

Answer

Method 1

In order to identify how much the deposit is, you need to find out what 20% ($\frac{20}{100}$) of £800 is. To do this, first you need to find out 1% ($\frac{1}{100}$) of £800:

800 ÷ 100 = 8

So 20% ($\frac{20}{100}$) of £800 is:

8 × 20 = 160

The deposit is £160.

Method 2

In order to calculate 10%, or $\frac{1}{10}$, you need to divide the number by 10:

800 ÷ 10 = 80

You now have 10% and you need 20%. Therefore you need to multiply your 10% by 2:

80 × 2 = 160

The deposit is £160.

2. Work out the following using any preferred method without a calculator:
   b. 50% of £170
   c. 30% of £250
   d. 25% of £120
   e. 75% of £56
   f. 80% of £95
   g. 5% of £620

Answer

There are different ways you could have worked out the answers to these calculations. One method is suggested in brackets in each case, but you may have used a different method.

a. £85 (170 ÷ 2 = 85)
b. £75 (Finding 10% is 250 ÷ 10 = 25, so 30% = 3 × 25 = 75)
c. £30 (120 ÷ 4 = 30)
d. £42 (75% is $\frac{3}{4}$; 56 ÷ 4 = 14, and then 14 × 3 = 42)
e. £76 (Finding 10% is 95 ÷ 10 = 9.50, so 80% = 8 × 9.50 = 76)
f. £31 (Finding 10% is 620 ÷ 10 = 62, so 5% = 62 ÷ 2 = 31)

5.1 Percentage increases and decreases

You'll often see percentage increases and decreases in sales and pay rises.

Figure 28 Increasing and decreasing percentages

Example: Anjali's pay rise

Anjali earns £18 000 per year. She is given a 10% pay rise. How much does she now earn?

Method

In order to identify Anjali's new salary, you need to find out what 10% ($\frac{10}{100}$) of

£18 000 is. To do this, first you need to find out 1% ($\frac{1}{100}$) of £18 000:

$$18\ 000 \div 100 = 180$$

So 10% ($\frac{10}{100}$) of £18 000 is:

$$10 \times 180 = 1\ 800$$

Alternatively, you could find 10% by dividing £18 000 by 10:

$$18\ 000 \div 10 = 1\ 800$$

Anjali's pay rise is £1 800, so her new salary is:

£18 000 + £1 800 = £19 800

Example: A sale at the furniture shop

A furniture shop reduces all of its prices by 20%. How much does a £300 double bed cost in the sale?

Method

In order to identify the new price of the double bed, you need to find out what 20% ($\frac{20}{100}$) of £300 is. To do this, first you need to find out 1% ($\frac{1}{100}$) of £300:

300 ÷ 100 = 3

So 20% ($\frac{20}{100}$) of £300 is:

20 × 3 = 60

The discount is £60, so the sale price of the double bed is:

£300 – £60 = £240

Alternatively, you could find 20% of £300 by dividing by 10 (to find 10%) and then multiplying by 2:

300 ÷ 10 = 30

30 × 2 = 60

Use the examples above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 35: Calculating percentage increases and decreases

1. You buy a car for £9 000. Its value depreciates (decreases) by 25% annually. How much will the car be worth at the end of the first year?
2. Since the start of the 21st century, the shares in the InstaBank have risen by 30%. If the price of one share was £10 in 2000, what is it worth now?
3. The same diamond ring is being sold at different prices, and with different percentage discounts, in two different shops. Which shop offers the better deal?

Figure 29 Comparing percentage discounts

Answer

1. In order to identify how much the value of the car will decrease by, you need to find out what 25% ($\frac{25}{100}$) of £9 000 is. You can work this out in several different ways. Find 1% ($\frac{1}{100}$) first:

   9 000 ÷ 100 = 90

   Then find 25% ($\frac{25}{100}$) by multiplying by 25:

   25 × 90 = 2 250

   Alternatively, you could have found 25% of £9 000 by dividing 9 000 by 4 (25% = $\frac{1}{4}$):

   9 000 ÷ 4 = 2 250

   The car's value depreciates by £2 250 in the first year, so the value of the car at the end of the first year will be:

   £9 000 – £2 250 = £6 750

2. It might be easier in this example to convert £10 into pence (£10 = 1 000p). In order to identify the new value of the share, you need to find out what 30% ($\frac{30}{100}$) of 1 000p is. To do this, first you need to find out 1% ($\frac{1}{100}$) of 1 000p:

1 000 ÷ 100 = 10

So 30% ($\frac{30}{100}$) of 1 000p is:

30 × 10 = 300

So the price of one share has increased by 300p (£3.00), so the one share is now worth:

£10 + £3 = £13

Alternatively, you could have found 10% by dividing by 10:

1 000 ÷ 10 = 100

You would then multiply by 3 to find 30%:

3 × 100 = 300

3. In order to identify Shop A's discount, you need to find out what 25% ($\frac{25}{100}$) of £500 is. To do this, first you need to find out 1% ($\frac{1}{100}$) of £500:

500 ÷ 100 = 5

So 25% ($\frac{25}{100}$) of £500 is:

5 × 25 = 125

The discount is £125, so you would have to pay:

£500 – £125 = £375

You may have worked out 25% of £500 differently. Because 25% is the same as $\frac{1}{4}$, you may have divided by 4:

500 ÷ 4 = 125

Alternatively, you could have halved and halved again:

500 ÷ 2 = 250

250 ÷ 2 = 125

In order to identify Shop B's discount, you need to find out what 10% ($\frac{10}{100}$) of £400 is. To do this, first you need to find out 1% ($\frac{1}{100}$) of £400:

400 ÷ 100 = 4

So 10% ($\frac{10}{100}$) of £400 is:

4 × 10 = 40

The discount is £40, so you would have to pay:

£400 – £40 = £360

You may have found 10% of £400 by dividing by 10:

400 ÷ 10 = 40

Whichever method you used, Shop B offers the best deal.

Summary

In this section you have learned how to calculate percentage increases and decreases. This will be useful when working out the value of a pay increase or how much an item will cost in a sale. You have also seen that there are different ways of working out percentages. You need to use the method that works for you.You may use different methods for working out different percentages.

5.2 Finding percentages using a calculator

There are different ways to work out percentages on a calculator. You can work out any percentage on a calculator by dividing by 100 first (to find 1%) and then multiplying the amount by the percentage you need.

If you were asked to work out 20% of 80, you could do the following:

80 ÷ 100 = 0.8

0.8 × 20 = 16

However, most calculators (including those on a mobile phone) will often have a percentage button. The percentage button looks like this:

Figure 30 The percentage button on a calculator

To successfully use it when calculating percentages you would enter the sum into your calculator as follows.

If you were asked to find 20% of 80, on your calculator you would input:

80 × 20%

This would give you the following answer:

80 × 20% = 16

If you were asked to find 20% of 80, on your calculator you would input:

20% × 80

This would give you the following answer:

20% × 80 = 16

Different calculators may work in different ways so you need to familiarise yourself with how to use the % button on your calculator.

Summary

In this section you have learned how to solve problems using percentages, and how to calculate percentage increases and decreases.

6 Equivalencies between fractions, decimals and percentages

Fractions, decimals and percentages are different ways of saying the same thing. It's an important skill to learn about the relationships (or 'equivalencies') between fractions, decimals and percentages to make sure you are getting the better deal.

Figure 31 Looking at equivalencies

Here are some common equivalencies. Try to memorise them – you will come across them a lot in everyday situations:

10% = $\frac{1}{10}$ = 0.1

20% = $\frac{1}{5}$ = 0.2

25% = $\frac{1}{4}$ = 0.25

50% = $\frac{1}{2}$ = 0.5

75% = $\frac{3}{4}$ = 0.75

100% = 1 = 1.0

Look at the following example. If you can identify equivalences, they'll make it easier to make simple calculations.

Example: Mine's a half

What is 50% of £200?

Method

Since 50% is the same as $\frac{1}{2}$, so:

50% of £200 = $\frac{1}{2}$ of £200 = £100

Refer to the common equivalencies above (if you need to) to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 36: Looking for equivalencies

1. What is 0.75 as a fraction?
2. If you walked 0.25 km each day, what fraction of a kilometer have you walked?
3. House prices have increased by $\frac{1}{2}$ in the last five years. What is this increase as a percentage?
4. A DIY shop is holding a '50% off' sale on kitchens. What is this discount as a fraction?
5. You buy an antique necklace for £3 000. After ten years, its value increases by 20%. What is this increase as a decimal?
6. A headline reads 'Number of Ulster Scots speakers predicted to drop by 10%'. What is this decrease as a fraction?
7. What percentage of an hour is 15 minutes?

Answer

1. 0.75 as a fraction is $\frac{3}{4}$.
2. 0.25 is the same as $\frac{1}{4}$, so you will have walked $\frac{1}{4}$ of a kilometre.
3. $\frac{1}{2}$ is the same as 50%, so the increase is 50%.
4. 50% is the same as $\frac{1}{2}$, so the discount as a fraction is $\frac{1}{2}$.
5. 20% is the same as 0.2, so the increase as a decimal is 0.2.
6. 10% is the same as $\frac{1}{10}$, so according to the headline, the number is predicted to drop by $\frac{1}{10}$.
7. Think of this as a fraction first: 15 minutes is a quarter ($\frac{1}{4}$) of an hour. $\frac{1}{4}$ is the same as 25%, so 15 minutes is 25% of an hour.

If you find that you are struggling to understand how to convert, please look at the following resource:

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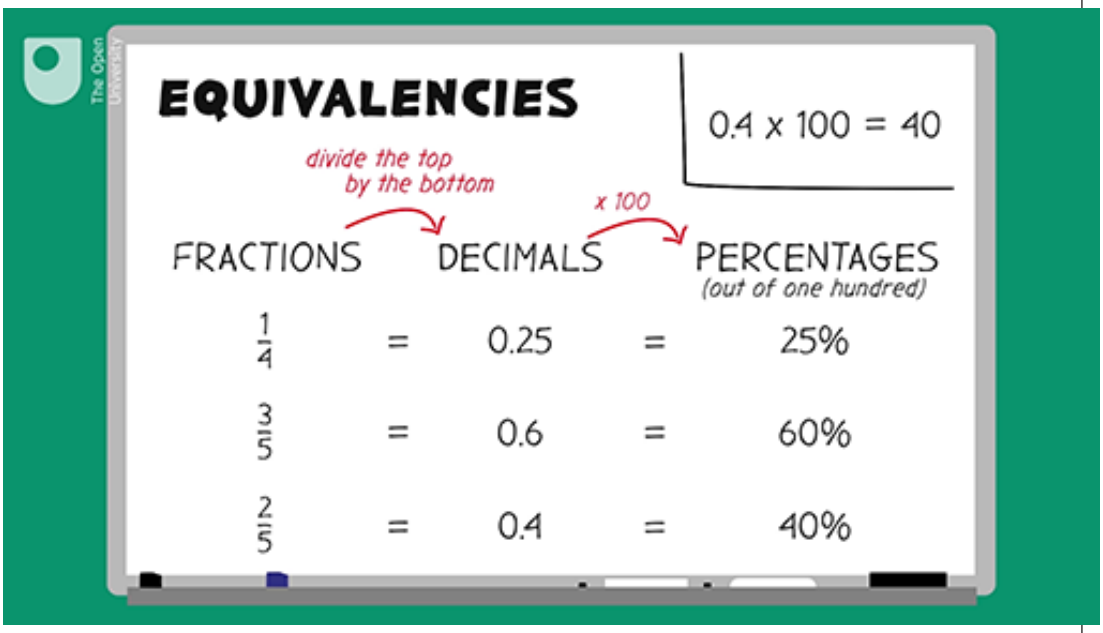

Summary

Knowing the common equivalencies between fractions, decimals and percentages is important when trying to compare discounts when shopping or choosing a tariff when paying your bills.

6.1 Changing a fraction to a decimal on a calculator

Acalculator can be used to develop our number skills.
It is important that you check your calculations are sensible by using estimation.
Always remember to clear the display before you start a new calculation.

Hereare some examples to show how to change a fraction to a decimal usinga calculator.

Figure 32 converting fractions to percentages using calculators

Activity

Using your calculator, convert the following fractions to decimals.

1. $\frac{1}{4}$
2. $\frac{3}{5}$
3. $\frac{3}{8}$
4. $\frac{7}{10}$
5. $\frac{9}{20}$
6. $\frac{5}{100}$

Answer

1. $\frac{1}{4}$ = 0.25
2. $\frac{3}{5}$ = 0.6
3. $\frac{3}{8}$ = 0.375
4. $\frac{7}{10}$ = 0.7
5. $\frac{9}{20}$ = 0.45
6. $\frac{5}{100}$ = 0.05

7 Ratios

Along with proportion (which you'll look at in the next section), you use ratio in everyday activities such as gardening, cooking, cleaning and DIY.

Figure 33 Talking ratios

Ratio is where one number is a multiple of the other. To find out more about ratios, read the following example.

Example: How to use ratios

Suppose you need to make up one litre (1 000 ml) of bleach solution. The label says that to create a solution you need to add one part bleach to four parts water.

This is a ratio of 1 to 4, or 1:4. This means that the total solution will be made up of:

One part + four parts = five parts

If we need 1 000 ml of solution, this means that one part is:

1 000 ml ÷ 5 = 200 ml

The solution needs to be made up as follows:

Bleach: one part × 200 ml = 200 ml

Water: four parts × 200 ml = 800 ml

So to make one litre (1 000 ml) of solution, you will need to add 200 ml of bleach to 800 ml of water.

You can check your answer by adding the two amounts together. They should equal the total amount needed:

200 ml + 800 ml = 1 000 ml

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 37: Using ratios

1. There are 17 students in a class: ten are male and seven are female. Write the ratio of male to female students.
2. The ratio of sand to cement required to make concrete is 3:1.
   If you have 40kg of cement, how much sand should you have?
3. Read the label from a bottle of wallpaper stripper:
   Dilute: add 1 part wallpaper stripper to 7 parts water.
   How much wallpaper stripper and water is needed to make 16 litres of solution?
4. To make a solution of hair colourant you need to add one part of hair colourant to four parts of water. How much hair colourant and water is needed to make 400 ml of solution?

Answer

1. 10:7
2. A ratio of 3:1 means three parts of sand to one part of cement, making four parts in total. If the cement (one part) is 40kg, then the sand (three parts) will be:
   3 × 40 kg = 120 kg
3. A ratio of 1:7 means one part of wallpaper stripper to seven parts of water, making eight parts in total.
   We need 16 litres of solution. If eight parts are worth 16 litres, this means that one part is worth:
   16 litres ÷ 8 = 2 litres
   So 16 litres of solution requires:
   Wallpaper stripper: one part × 2 litres = 2 litres
   Water: seven parts × 2 litres = 14 litres
   You can confirm that these figures are correct by adding them and checking that they match the amount needed:
   2 litres + 14 litres = 16 litres
4. The ratio of 1:4 means one part hair colourant to four parts water, making five parts in total.

We need 400 ml of solution. If five parts are worth 400 ml, this means that one part is worth:

400 ml ÷ 5 = 80 ml

So 400 ml of solution requires:

Hair colourant: one part × 80 ml = 80 ml

Water: four parts × 80 ml = 320 ml

You can confirm that these figures are correct by adding them and checking that they match the amount needed:

80 ml + 320 ml = 400 ml

Summary

You have now learned how to use ratio to solve problems in everyday life. This could be when you are mixing concrete, hair colourant or screen wash. Can you think of any more examples where you might need to use ratio?

8 Proportion

Proportion is used to scale quantities up or down by the same ratio. This is shown in the following example – what happens if you want to adapt a favourite recipe to serve more people?

Example: Using proportion for more portions …

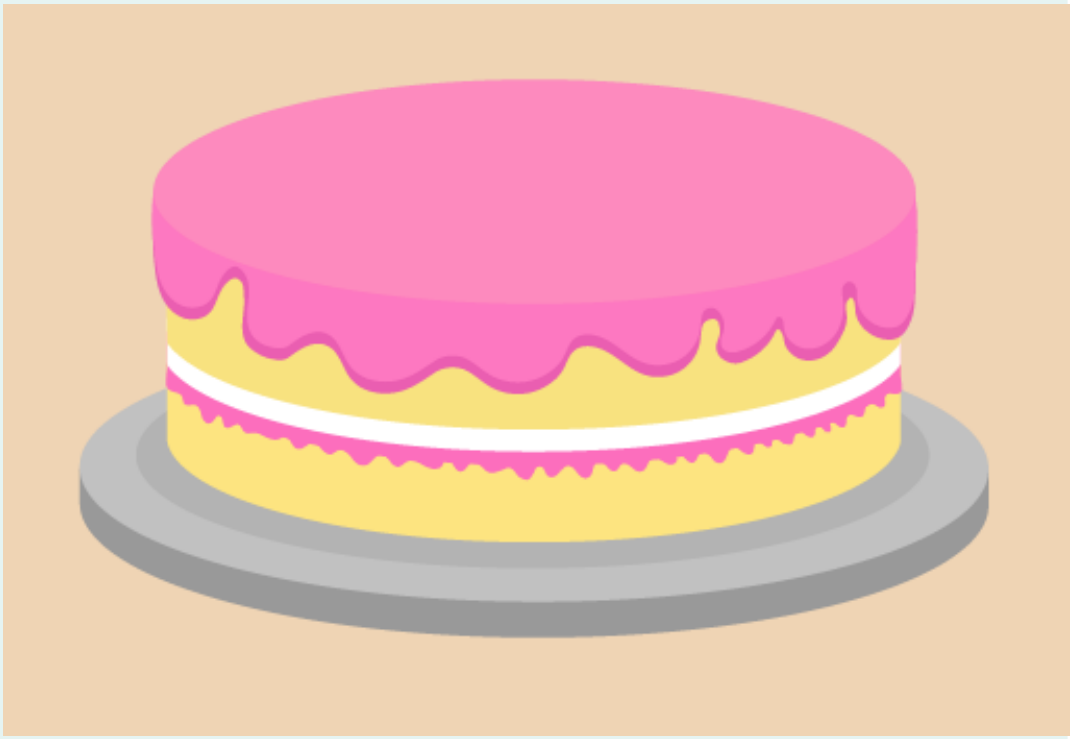

Figure 34 A cake

Here is a recipe for making a sponge cake for four people:

- 4 oz self-raising flour
- 4 oz caster sugar
- 4 oz butter
- 2 eggs

How much of each ingredient is needed to make a cake for eight people?

Method

To make a cake for eight people you need twice the amount of each ingredient:

- 8 oz self-raising flour (4 × 2)
- 8 oz caster sugar (4 × 2)
- 8 oz butter (4 × 2)
- 4 eggs (2 × 2)

Use the example above to help you with the following activity. Remember to check your answers once you have completed the questions.

Activity 38: Scaling up recipes

1. This recipe makes ten large cookies:
   - 220 g self-raising flour
   - 150 g butter
   - 100 g caster sugar
   - 2 eggs

   How much of each ingredient is needed to make 20 cookies?
2. This recipe makes four servings of strawberry milkshake:
   - 800 ml milk
   - 200 g strawberries
   - 4 scoops of ice cream

   How much of each ingredient is needed for two people?
3. This recipe makes dessert for two people:
   - 300 ml milk
   - 60 g powder

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

Answer

1. To make 20 cookies you need twice as much of each ingredient:
   - 440 g flour (220 × 2)
   - 300 g butter (150 × 2)
   - 200 g sugar (100 × 2)
   - 4 eggs (2 × 2)
2. To make milkshakes for two people you need half as much of each ingredient:
   - 400 ml milk (800 ÷ 2)
   - 100 g strawberries (200 ÷ 2)
   - 2 scoops of ice cream (4 ÷ 2)
3. To make dessert for six people you need three times the amount of each ingredient:
   - 900 ml milk (300 × 3)
   - 180 g powder (60 × 3)

Once you have checked your answers and have got them all correct, please have a go at the next activity.

Activity 39: Looking at ratio and proportion

Note: Calculators not allowed.

1. A label on a bottle of curtain whitener says that you should add one part concentrated curtain whitener to nine parts water.

   How much curtain whitener and water is needed to make up a 2 000 ml solution?
2. Here is a recipe for a low-fat risotto for two people:

   200 g mushrooms
   175 g rice
   180 ml water
   180 ml evaporated milk
   Salt and pepper

   How much of each ingredient is needed if you want to cook enough risotto for six people?

Answer

1. A ratio of 1:9 means one part curtain whitener to nine parts water, making ten parts in total.

   You need 2 000 ml of solution. If ten parts are worth 2 000 ml, this means that one part is worth:

   2 000 ml ÷ 10 = 200 ml

   So 2 000 ml of solution requires:

   Curtain whitener: one part × 200 ml = 200 ml
   Water: nine parts × 200 ml = 1 800 ml

   You can confirm that these figures are correct by adding them and checking that they match the amount needed:

   200 ml + 1 800 ml = 2 000 ml
2. To make enough risotto for six people you need three times as much of each ingredient:

   600 g of mushrooms (200 × 3)
   525 g of rice (175 × 3)
   540 ml of water (180 × 3)
   540 ml of evaporated milk (180 × 3)

Summary

In this section you have learned how to use proportion to solve simple problems in everyday life, for example when adapting recipes.

9 Word formulas

You see formulas in everyday life, but sometimes it can be tricky to spot one that's written in words.

So what's a formula? It's a rule that helps you to work out an amount, you will see this when cooking, working out how much you are going to get paid or your household bills.

You use formulas a lot throughout a normal day, as the examples below show.

Example: A formula to calculate earnings

Daniel is paid £6.50 per hour. How much does he earn in ten hours?

Method

You're told that 'Daniel is paid £6.50 per hour'.

This is a formula. You can use it to work out how much Daniel earns in a given number of hours. The calculation you need to do is:

Daniel's pay = £6.50 × number of hours

You've been asked how much Daniel earns in ten hours, so put '10' into the calculation in place of 'number of hours':

£6.50 × 10 = £65.00

You can use the same formula to work out how much Daniel earns for any number of hours.

You will need to be able to use formulas that have more than one step. The next example looks at a two-step formula.

Example: A cooking formula

What are the two steps in word formulas? Watch the following video to find out.

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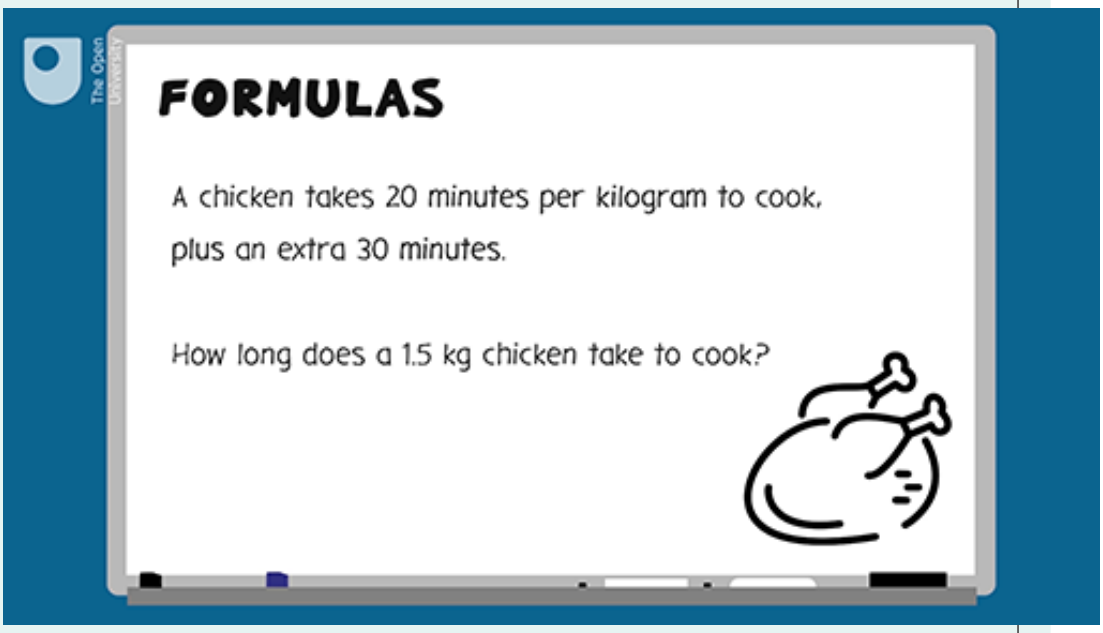

Now test your learning with the following word problems.

Activity 40: Using formulas

1. Harvey earns £7.75 per hour. How much will Harvey earn in 8 hours?

Answer

To answer this you need to multiply the amount Harvey earns in an hour (£7.75) by the number of hours (eight):

£7.75 × 8 = £62.00

2. A joint of pork takes 40 minutes per kilogram to cook, plus an extra 30 minutes to ensure the outside is crisp.
   b. How long will it take for a 2 kg joint of pork to cook?
   c. How long will it take for a 1.5 kg joint of pork to cook?

Answer

a. You need to use a two-step formula to answer each of these questions. To work out how long a 2 kg joint of pork takes to cook, you'll need a formula with two steps:

Step 1: 40 minutes × number of kilograms

Step 2: Add 30 minutes

Written as a formula, this is:

(40 × number of kilograms) + 30 = cooking time

So a 2 kg joint would take:

(40 × 2) + 30 = 110 minutes, or 1 hour and 50 minutes

b. Using the same formula, a 1.5 kg joint would take:

(40 × 1.5) + 30 = 90 minutes, or 1 hour and 30 minutes

3. A mobile phone contract costs £15 a month for the first four months, then £20 a month after that. How much will the phone cost for one year?

Answer

The information in the question gives you two formulas. To answer the question you need to find the answers to both formulas and add the results together.

The contract costs £15 a month for the first four months. So the formula for this part of the contract is:

£15 × 4 = £60

After the first four months the contract is £20 a month. The question asks you the total cost of the phone contract for one year, so you need to calculate how much you would pay for another eight months:

£20 × 8 = £160

So the total cost of the contract for one year is:

£60 + £160 = £220

10 A quick reminder: checking your work

Next you can take a quiz to review what you have learned in this session. For this and later quizzes in the course you should check your answers. A check is an alternative method or reverse calculation – you may have heard this being called an inverse calculation. If the check results in a correct answer, it means that your original sum is correct too. For example, you may have made the following calculation:

$20 – 8 = 12$

A way of checking this would be:

$12 + 8 = 20$

Alternatively, if you wanted to check the following calculation:

$80 \times 2 = 160$

A way of checking this would be:

$160 \div 2 = 80$

If you have carried out several calculations to get to your final answer, you only need to reverse one as a check.

10.1 Interpreting rounding errors and estimating answers

You can use the rounding of numbers to estimate the answer to a calculation.

Here are some examples where we can use estimate the answer much quicker than calculating.

We round each number to the nearest 10, 100, 1000 depending on the place value of the first digit.

Pippa sold 684 motorbike racing programmes at £10.49 each.

Using rounding and estimation, the calculation would be:

700 × £10 = £7000

The exact calculation would be: 684 × £10.49 = £7175.16.

Samuel sold 204 limited edition programmes at £14.65.

Using rounding and estimation, the calculation would be:

200 × £15 = £3000

The actual calculation would be: 205 × £14.65 = £3003.25

By using rounding and estimation, you can judge whether your answers are sensible.

Activity 41: Rounding and estimating answers

Liam sold 432 concert tickets at £25.75 each.

Using rounding and estimation, calculate how much he earned and then, by using a calculator, calculate the exact earnings.

Answer

Using rounding and estimation, the calculation would be:

400 × £26=£10,400

The exact calculation would be:

432 × £25.75=£11,124

Rounding errors on a calculator

Sometimes the results on a calculator may have recurring digits which will need to be rounded before further use. For example:

3.99999999: rounded to the whole number, i.e. 4

6.99999999: rounded to the whole number, i.e. 7

0.11111111: rounded to 1 decimal place, i.e. 0.1

11 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.

12 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:

- understand and use whole numbers, and understand negative numbers in practical contexts
- add, subtract, multiply and divide whole numbers using a range of strategies
- find fractions of whole numbers
- find common percentages of whole numbers and calculate percentage increases and decreases
- add, subtract, multiply and divide decimals up to two decimal places
- understand and use equivalences between common fractions, decimals and percentages
- use a calculator to convert a fraction into a decimal
- solve simple problems involving ratio, where one number is a multiple of the other
- use simple formulas expressed in words for one- or two-step operations
- use estimation to check answers obtained with a calculator.

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.

Session 2: Units of measure

Introduction

You come across problems requiring calculation every day. These problems could be related to money, time, length, weight, capacity and temperature. For example, if you were buying a new washing machine, you would measure the space where you want to put it under your worktop and make sure you chose a washing machine short enough to fit the space.

In this session of the course you will find out about measuring and calculating length, distance, weight, capacity (volume), temperature and time. You will learn how to use different metric measurements, such as kilometres, metres and centimetres, grams and kilograms, and litres.

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

- measure and understand the sizes of objects
- read a mileage chart to find the distance between places
- find out how heavy things are and understand weights
- measure and understand volumes and capacities
- express time using the 24-hour clock
- carry out calculations with time.

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1 Using metric measurements: length

We can use different units to measure the length, width or height of items. We are going to focus on metric units.

Metric units of length

Metric unit	Abbreviation
millimetre	mm
centimetre	cm
metre	m
kilometre	km

A millimetre is the smallest metric unit used by most people to measure the length of something. You would commonly use millimetres to measure items that are really small or need to be measured veryaccurately; for example, the dimensions of a washing machine is usually measured in millimetres.

Centimetres and metres are also commonly used to measure items for everyday tasks.

Kilometres would be used to measure the distance between places. A runner may clock the distance that they have run in kilometres.

Activity 1: Which unit?

Which unit would you use to measure the following?

1. A washing machine
2. The distance between Belfast and Omagh
3. A nail
4. A kitchen
5. A bus
6. A park run
7. Your waist
8. A sofa
9. An envelope
10. A screw head

Answer

Suggested answers:

1. Centimetres or millimetres
2. Kilometres
3. Centimetres or millimetres
4. Metres
5. Metres
6. Kilometres
7. Centimetres

8. Centimetres or metres
9. Centimetres
10. Millimetres

1.1 Instruments of measure

So what do you use to measure things? If you were to measure something small, such as a screw, you would probably use a ruler. To measure something bigger, like the length of a room or garden, you would probably use a tape measure.

You could try estimating the size of something before measuring it, which would help you to decide what tool you need to measure it. If you wanted to measure the walls of a room before redecorating, you'd get a more accurate measurement using a tape measure rather than a 30-centimetre ruler! After you've made an estimate you can check how accurate it is by measuring the object.

How long is a pen? Find a pen, make an estimate of how long you think it is and then measure it accurately using a ruler.

Hint: To help you to estimate the size of an item, consider it in relation toother items of known length:

- The eye of a needle is about 1 millimetre (mm) wide.
- The width of the fingernail on your little finger is about 1 centimetre (cm).
- A small ruler is 15 centimetres long.
- A large ruler is 30 centimetres long.
- A door frame is approximately 2 metres (m) high.
- It would take approximately 20 minutes to walk 1 kilometre (km).

Activity 2: How long?

Match the following items to the approximate measurement:

175 cm

15 cm

30 cm

4 m

25 m

10 mm

20 km

Match each of the items above to an item below.

The height of a man

The length of a pen

The length of an A4 piece of paper

The height of a double-decker bus

The length of a swimming pool

The length of an eyelash

The length of a half marathon

1.2 Measuring accurately

To measure accurately, line up one end of the pen with the 0 mark on the ruler. If there is no 0 mark, use the end of the ruler. Hold the ruler straight against the pen. Which mark does the other end come to?

Hint: Be careful with the bit of ruler or tape measure that comes before the first mark! Make sure you line up whatever you're measuring with the 'zero' mark.

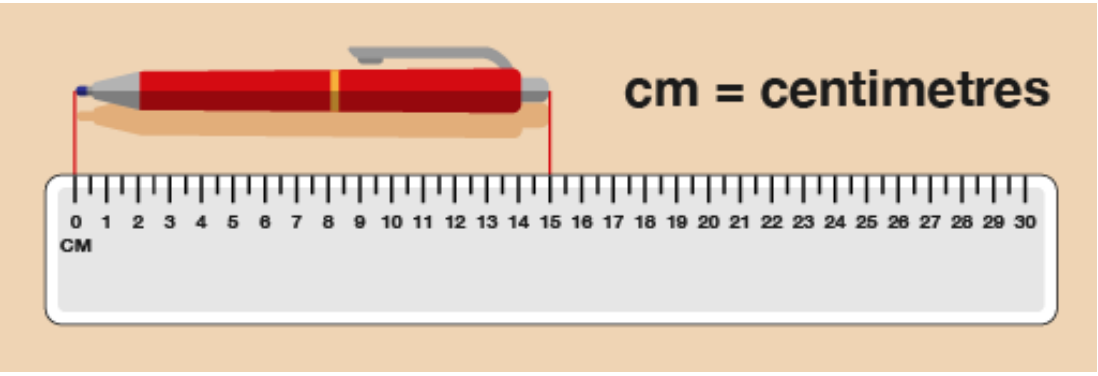


Figure 1 Measuring a pen

You can see from this diagram that the pen is 15 cm long.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 3: Building a shelf for DVDs

1. You want to build a shelf to hold some DVDs. You need to make sure that it's big enough! How tall is a DVD case?

Figure 2 Measuring a DVD case

2. You have run out of screws. Before you go to buy some more, you need to measure the last screw you have to make sure you buy some more in the same size. How long is this screw?

Figure 3 Measuring a screw

3. How far is it across the head of the screw?
   Hint: Draw lines from the edge of the screw head down to the ruler to help you measure it.

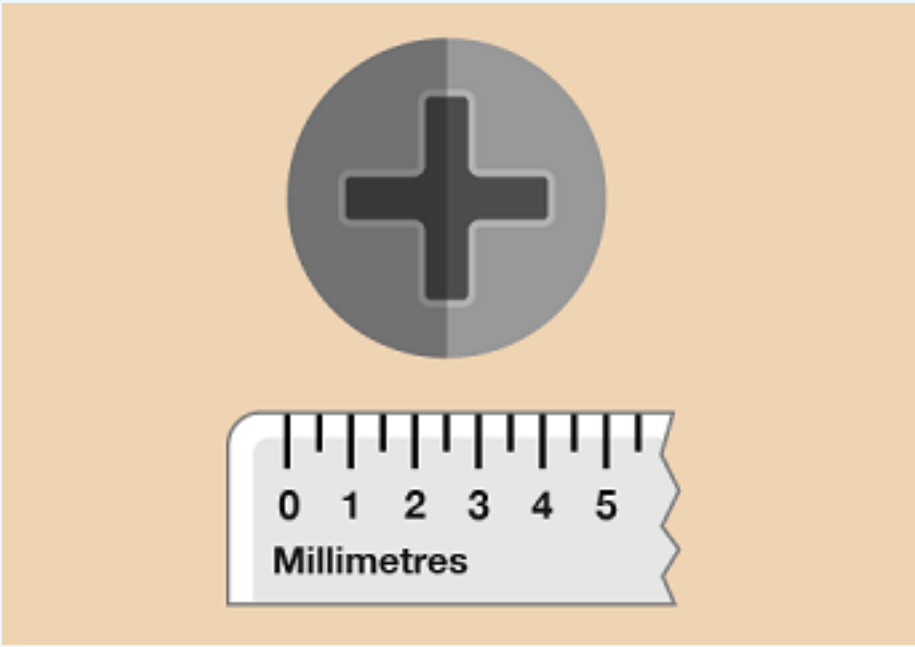


Figure 4 Measuring a screw head

Answer

1. The DVD case is 19 cm tall.

Figure 5 Measuring a pen (answer)

2. The end of the screw is halfway between 2 and 3 cm, so the screw is 2.5 cm ($2\frac{1}{2}$ cm) long. Note here how the measurement is not a whole number. Often items have to be measured very precisely: when this is the case, it may not be appropriate to round off to the nearest centimetre, for instance.

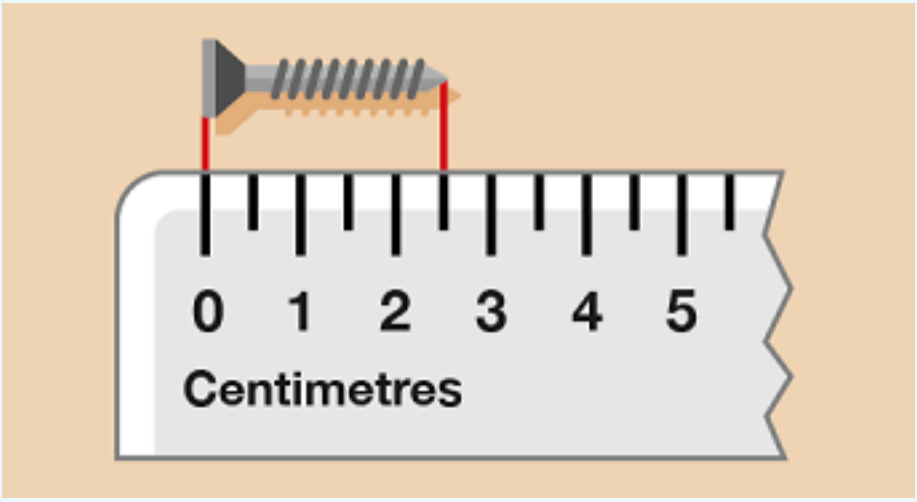


Figure 6 Measuring a screw (answer)

3. The screw head is 5 mm wide.

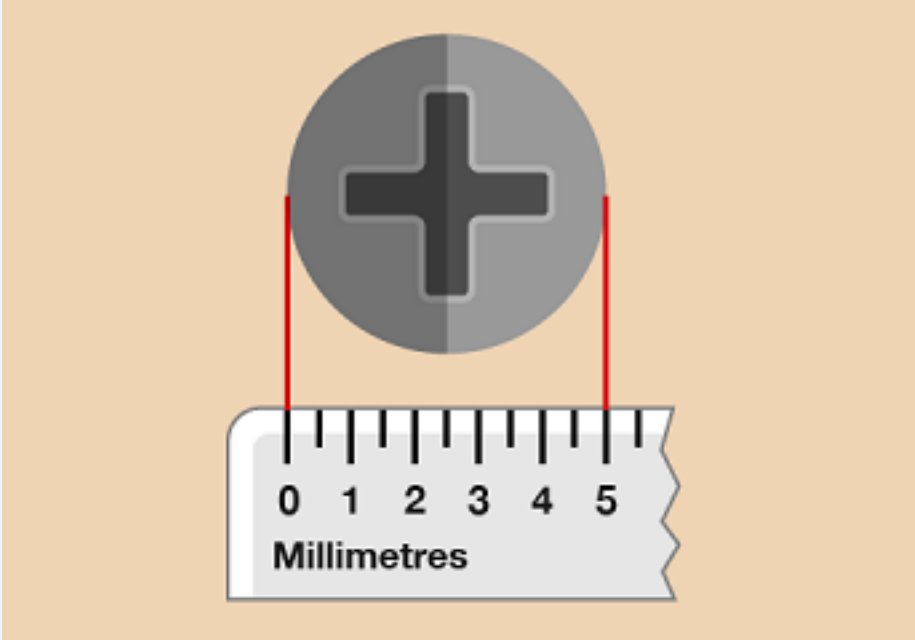


Figure 7 Measuring a screw head (answer)

1.3 Measuring in millimetres and centimetres

When you're measuring an item, you need to decide whether to measure it in millimetres, centimetres or metres. Often, your decision will be based on the size of the item, why you are measuring it and how accurate you need the measurement to be.

When you measure an item, you can actually express the same measurement in different ways. To help you to do this, you need to know some metric measure facts:

Facts

10 millimetres = 1 centimetre

100 centimetres = 1 metre

1 000 metres = 1 kilometre

Starting with the smallest, metric units of length are millimetres (mm), centimetres (cm) and metres (m).

Kilometres (km) are used to measure distance.

Example: Writing measurements in millimetres and centimetres

You can express a measurement in millimetres, centimetres or a combination of both. Look at the ruler below. What measurement is the arrow pointing to?

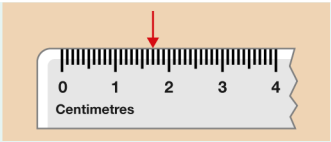


Figure 8 Measuring a pen

Method

The numbers displayed on the ruler represent centimetres. Each line in between each whole centimetre is a millimetre; ten millimetres is equal to one centimetre. So you can say that thearrow is pointing to:

1 cm 7 mm

However, you could write it all in centimetres. The length is one whole centimetre plus seven additional millimetres, so you would write:

1.7 cm

Note how the decimal point separates the number of centimetres from the number of millimetres. Alternatively you could write this measurement in millimetres. One centimetre equals ten millimetres, so:

1 cm 7 mm = 10 mm + 7 mm = 17 mm

Now try the following activity.

Activity 4: Writing measurements in different ways

Complete the gaps in the table to show the same measurement writtenin three different ways. The first one has been done for you. Remember tocheck your answers.

Measurements

Centimetres and millimetres	Centimetres	Millimetres
1 cm 7 mm	1.7 cm	17 mm
8 cm 9 mm	*Provide your answer...*	*Provide your answer...*
Provide your answer...	9.4 cm	*Provide your answer...*

Provide your answer...	*Provide your answer...*	63 mm
12 cm 6 mm	*Provide your answer...*	*Provide your answer...*
Provide your answer...	*Provide your answer...*	105 mm
Provide your answer...	20.1 cm	*Provide your answer...*

Answer

Measurements

Centimetres and millimetres	Centimetres	Millimetres
1 cm 7 mm	1.7 cm	17 mm
8 cm 9 mm	8.9 cm	89 mm
9 cm 4 mm	9.4 cm	94 mm
6 cm 3 mm	6.3 cm	63 mm
12 cm 6 mm	12.6 cm	126 mm
10 cm 5 mm	10.5 cm	105 mm
20 cm 1 mm	20.1 cm	201 mm

1.4 Converting units

You may often need to convert between different units of length. For example, if you were fitting a kitchen or measuring a piece of furniture, you might need to convert between millimetres and centimetres, or centimetres and metres.

Figure 9 shows you how to convert between metric units of length.

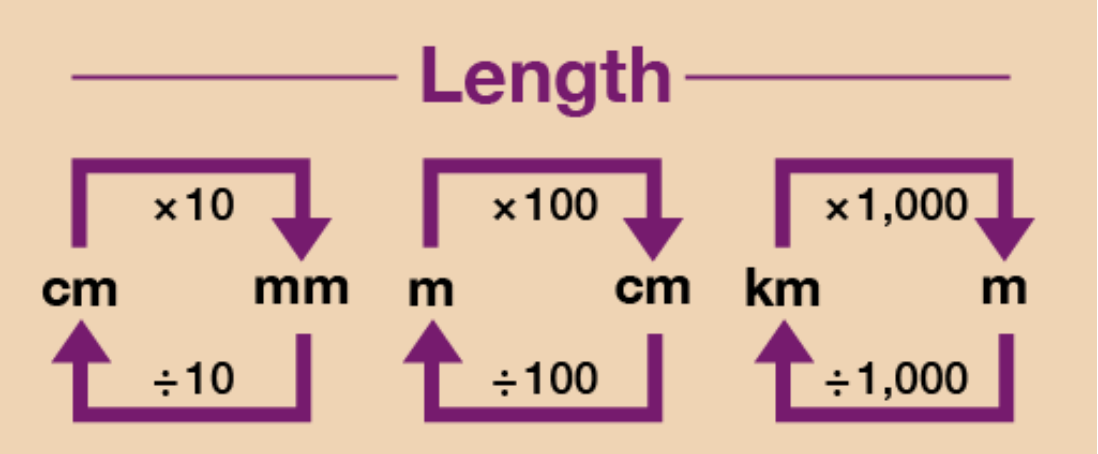


Figure 9 A conversion chart for length

Hint: To convert from a bigger unit to a smaller unit (such as cm to mm), youmultiply. To convert from a smaller unit to a bigger unit (such as mm to cm), you divide.

Example: Converting units of length

1. What is 8.5 metres in centimetres?
2. What is 475 centimetres in metres?

Method

1. Converting between metric units involves multiplying or dividing by 10, 100 or 1 000, which you will have practised in Session 1. As you can see from Figure 9, you need to multiply by 100 to convert from metres (m) to centimetres (cm). So converting 8.5 m into centimetres would be:

   8.5 m × 100 = 850 cm
2. As you can see from Figure 9, you need to divide by 100 to convert from centimetres (cm) tometres (m). So converting 475 cm into metres would be:

   475 cm ÷ 100 = 4.75 m

Now try the following activities.

Activity 5: Converting lengths

Use Figure 9 above to help you with the following activity.

Please work these out without using a calculator. You may wish to look back at Session 1 first to remind you how to multiply and divide by 10, 100 and 1 000.

1. 20 mm = ? cm
2. 54 mm = ? cm
3. 0.5 cm = ? mm
4. 8.6 cm = ? mm

5. 400 cm = ? m
6. 325cm = ? m
7. 12 m = ? cm
8. 6.8 m = ? cm
9. 450 mm = ? m (**Hint:** You will need to look at the chart for how to convert from millimetres to centimetres and then centimetres to metres)
10. 2 m = ? mm
11. 8 km = ? m
12. 500 m = ? km
13. I am 1.6 m tall. How tall am I in centimetres?
14. You are fitting kitchen cabinets. The gap for the last cabinet is 80 cm. The sizes of the cabinets are shown in millimetres. Which size should you look for?
15. You want to buy 30 cm of fabric. The fabric is sold by the metre. What should you ask for?

Answer

1. 20 mm ÷ 10 = 2 cm
2. 54 mm ÷ 10 = 5.4 cm
3. 0.5 cm × 10 = 5 mm
4. 8.6 cm × 10 = 86 mm
5. 400 cm ÷ 100 = 4 m
6. 325 cm ÷ 100 = 3.25 m
7. 12 m × 100 = 1 200 cm
8. 6.8 m × 100 = 680 cm
9. There are 10 mm in 1 cm, so divide by 10 first to convert 450 mm to 45 cm. There are 100 cm in 1 m, so divide 45 cm by 100 to get the answer, 0.45 m.
10. There are 100 cm in 1 m, so multiply by 100 first to convert 2 m to 200 cm. There are 10 mm in 1 cm, so multiply 200 cm by 10 to get the answer, 2 000 mm.
11. 8 km × 1 000 = 8 000 m
12. 500m ÷ 1 000 = 0.5 km
13. There are 100 cm in 1 m, so to convert from metres to centimetres you need to multiply by 100:

    1.6 m × 100 = 160 cm
14. To convert from centimetres to millimetres, you need to multiply the figure in centimetres by 10. The size is 80 cm, so the answer is:

    80 × 10 = 800 mm
15. To convert from centimetres to metres, you need to divide the figure in centimetres by 100. The length of fabric you need is 30 cm, so the answer is:

    30 ÷ 100 = 0.3 m

Activity 6: Matching the same measurement

Match the following measurements:

5 m

15 mm

150 mm

50 mm

0.5 km

150 cm

15 m

1.5 km

Match each of the items above to an item below.

500 cm

1.5 cm

15 cm

5 cm

500 m

1.5 m

1 500 cm

1 500 m

1.5 Calculate using metric units of length

You may need to carry out calculations with length. This may require you to convert between metric units, either before you carry out the calculation or at the end.

Example: Bunting

Fran is putting up bunting. She has three lengths of bunting, measuring 160 cm, 240 cm and 95 cm. How many metres of bunting does she have?

Method

All of the units are given in centimetres, so you can add them together:

165 cm + 240 cm + 95 cm = 500 cm

The question asks for the answer in metres, so you need to convert 500 cm into metres:

500 cm ÷ 100 = 5 m

So Fran will have 5 m of bunting.

Example: Length of shelves

Dixie wants to put up a shelf in an alcove. The alcove is 146 cm wide. She has a plank of wood that is 2 m long. How much wood will she have left over?

Method

The plank of wood is in metres, so you need to convert this into centimetres:

2 m × 100 = 200 cm

200 cm – 146 cm = 54 cm

So Dixie will have 54 cm left over.

Now try the following activity.

Activity 7: Carrying out calculations with length

Calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers once you have completed the questions.

1. You are making Christmas cards for a craft stall. You want to add a bow, which takes 10 cm of ribbon, to each card. You plan to make 50 cards. How many metres of ribbon do you need?
2. You want to make a garden planter that measures 1.5 m by 60 cm. How much wood will you need to buy? (**Hint:** you will need two planks of each length to make the planter.)
3. Sally is making a pair of curtains. Each curtain requires 1.8 m of fabric plus 20 cm each for hemming. How many metres of fabric will she need?
4. John wants to put shelving in his garage to hold storage boxes. Each storage box is 45 cm wide and John wants to be able to put four boxes on each shelf. He has seen some shelves that are 2 m wide. Would they be suitable?

.....

Answer

You will have found it useful to refer to the metric conversion diagram for this activity.

1. First you need to work out how many centimetres of ribbon you need:

   10 × 50 = 500 cm

Notice that the question asks how many metres of ribbon you need, rather than centimetres. So you need to divide 500 cm by 100 to find out the answer in metres:

500 ÷ 100 = 5 m

2. The measurements for the planters are in different units, so you need to convert everything into centimetres or metres first. The question does not specify whether your answer needs to be in centimetres or metres, so either will be OK.

   Using Method 1, converting to centimetres, note that the length of the planter is 1.5 m:

   1.5 × 100 = 150 cm

The short sides are already in centimetres, so you can now add up the total for all four sides:

150 cm + 60 cm + 150 cm + 60 cm = 420 cm

Using Method 2, converting to metres, the length of the planter is already in metres. The short sides are 60 cm, which you need to convert to metres:

60 ÷ 100 = 0.6 m

You can now add up the total for the four sides:

1.5 m + 0.6 m + 1.5 m + 0.6 m = 4.2 m

3. The measurements for the curtains and the hem are given in different units. The question asks for the answer in metres, so you need to convert everything into metres first:

   20 cm ÷ 100 = 0.2 m

You can now add up the total amount of fabric needed for the curtains:

1.8 m + 1.8 m + 0.2 m + 0.2 m = 4.0 m (4 m)

4. The measurements for the storage boxes and shelves are given in different units, so you need to convert everything into centimetres or metres first. The question does not specify whether your answer needs to be in centimetres or metres, so either will be OK.

   Using Method 1, converting to centimetres, the shelves are 2 m wide. First you need to convert this to centimetres:

   2 m × 100 = 200 cm

The storage boxes are already in centimetres, so you can now work out the width of four of them.

45 cm × 4 = 180 cm

So the shelves would be suitable.

Using Method 2, converting to metres, the shelves are already in metres, but the boxes measure 45 cm.

45 cm ÷ 100 = 0.45 m

I need four boxes:

0.45 m × 4 = 1.80 m (1.8 m)

The shelves would be suitable. Another way of doing this is to work out how wide four boxes would be incentimetres and convert the answer to metres:

45 cm × 4 = 180 cm
180 cm ÷ 100 = 1.80 m (1.8 m)

Summary

Throughout this section you have looked at measuring and calculating length. You have used different metric measurements, such as millimetres, centimetres, metres and kilometres. You can now:

- measure and understand the sizes of objects
- understand different units of length
- convert between different units of length
- carry out calculations with length.

2 Mileage charts

Can you think of a time when it is useful to be able to understand and work out distances between places? It's useful to know how far apart places are if you're planning a trip. If your job involves lots of travelling from place to place, you need to calculate how much mileage you do so that you can reclaim how much money you've spent on petrol.

How far is it from your home to the nearest shopping centre?

Your answer is probably something like 'three miles' or 'ten kilometres'. Distances between places are often measured in either miles or kilometres. Road signs in the UK and USA use miles, whereas in Canada and Europe, for example, the road signs are in kilometres. What's the difference between the two?

Kilometres are a metric measure of distance.

1 000 metres (m) = 1 kilometre (km)

Miles are an imperial measure of distance.

1 mile = 1 760 yards

One mile is a bit less than two kilometres.

Because most maps and road signs in the UK use miles, in this section you'll work with miles.

If you have to plan a trip, it's useful to look at a mileage chart. This shows you how far it is between places:

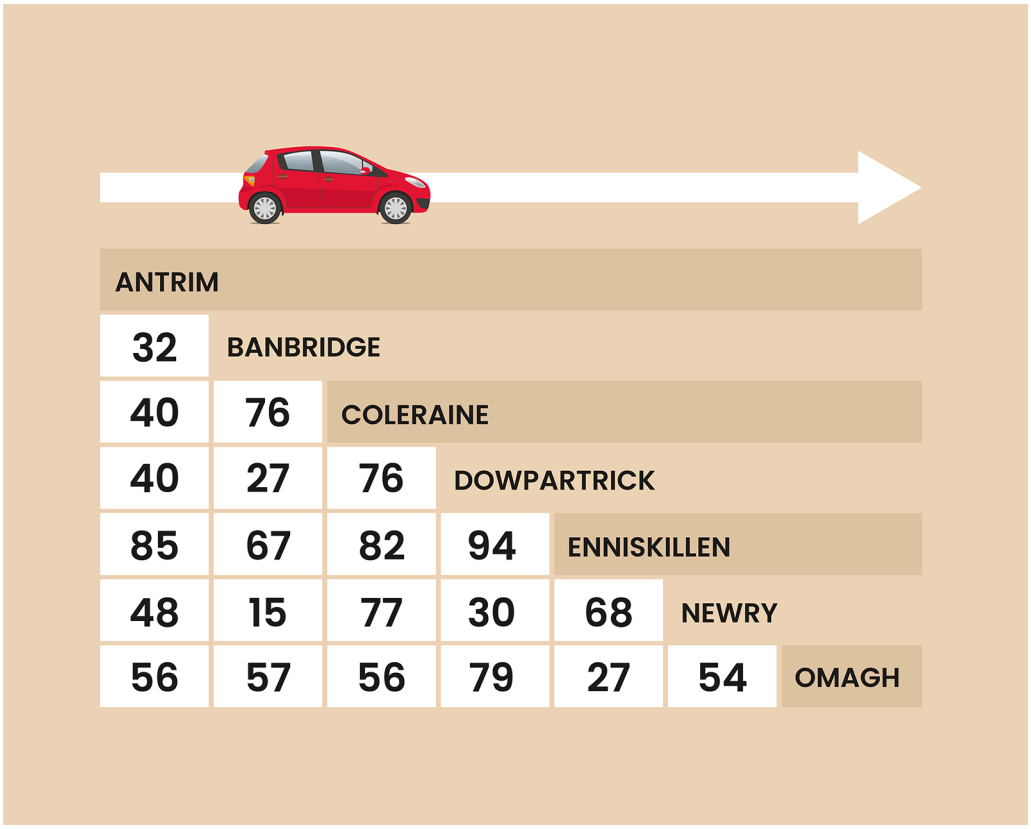


Figure 10 A mileage chart.

To read the chart, find where you want to start from and where you want to go. Then follow the rows and columns until they meet.

Example: Finding the distance

How far is it from Antrim to Newry?

Method

To calculate this, you need to find where Antrim and Newry meeton the chart. As you can see from Figure 10, it is 48 miles from Antrim to Newry.

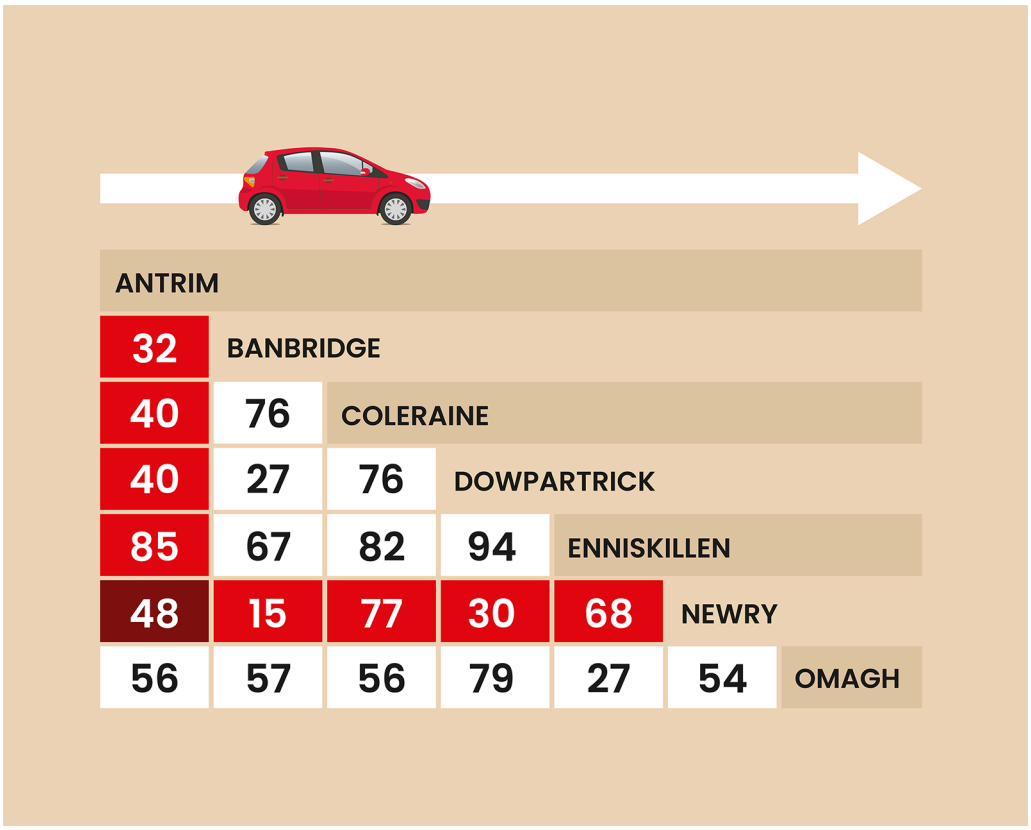


Figure 11 Distance from Antrim to Newry, on a mileage chart.

Now try the following activity.

Activity 8: Reading a mileage chart

Now use the mileage chart in Figure 10 to answer the following questions. Remember to check your answers.

1. What is the distance from Banbridgeto Omagh?
2. Coleraine FC's next match inthe NIFL Premiership is against Newry City. How far will supporters have totravel to watch the football match? (**Hint:** Don't forget to calculate the distance for a returnjourney.)
3. Which two towns / cities are the closest?

Answer

1. The distance between Banbridgeand Omagh is 57 miles.
2. Thedistance from Coleraine to Newry is 77 miles, so the Coleraine FC supporterswould have to travel 154 miles (77 × 2).

3. To calculate this, you mustcheck the table to see which value is the smallest. We can can see that 15miles is the smallest. Going vertically from 15 we can see the town ofBanbridge, going horizontally from 15 to the right we can see the city Newry.Therefore the two towns/cities that are closest are Banbridge and Newry.

Example: A European journey

Look at Figure 12. It has a different layout to the previous mileage chart.

Some European cities are listed down the left hand-side of the chart, and a series of ports are listed along the top.

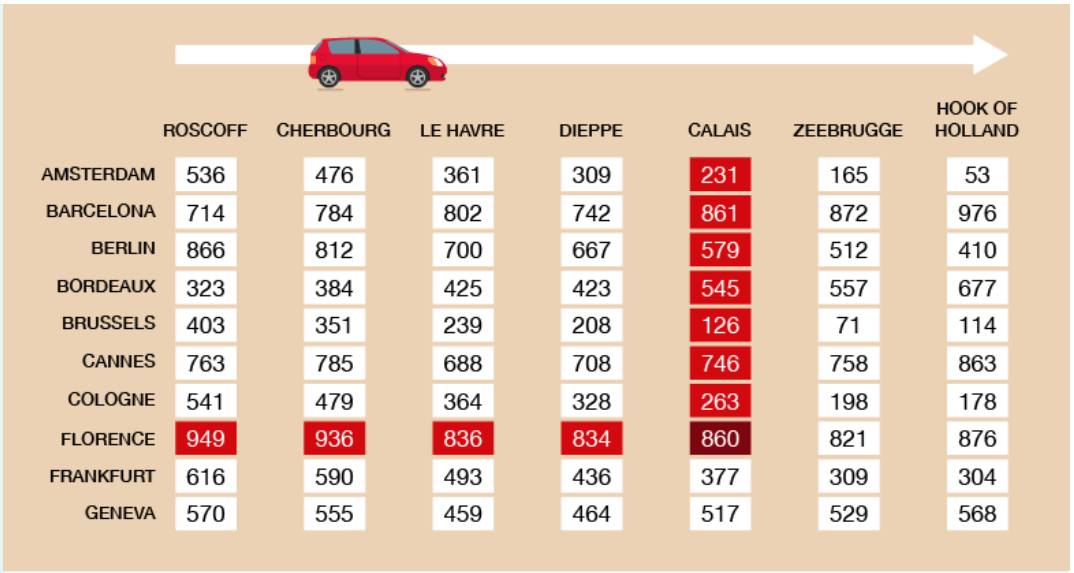
	ROSCOFF	CHERBOURG	LE HAVRE	DIEPPE	CALAIS	ZEEBRUGGE	HOOK OF HOLLAND
AMSTERDAM	536	476	361	309	231	165	53
BARCELONA	714	784	802	742	861	872	976
BERLIN	866	812	700	667	579	512	410
BORDEAUX	323	384	425	423	545	557	677
BRUSSELS	403	351	239	208	126	71	114
CANNES	763	785	688	708	746	758	863
COLOGNE	541	479	364	328	263	198	178
FLORENCE	949	936	836	834	860	821	876
FRANKFURT	616	590	493	436	377	309	304
GENEVA	570	555	459	464	517	529	568

Figure 12 A mileage chart for a European tour

Use the mileage chart to find the distance between Florence and Calais.

Method

To answer this, you need to find the row for Florence and go along it until it meets the column for Calais.



	ROSCOFF	CHERBOURG	LE HAVRE	DIEPPE	CALAIS	ZEEBRUGGE	HOOK OF HOLLAND
AMSTERDAM	536	476	361	309	231	165	53
BARCELONA	714	784	802	742	861	872	976
BERLIN	866	812	700	667	579	512	410
BORDEAUX	323	384	425	423	545	557	677
BRUSSELS	403	351	239	208	126	71	114
CANNES	763	785	688	708	746	758	863
COLOGNE	541	479	364	328	263	198	178
FLORENCE	949	936	836	834	860	821	876
FRANKFURT	616	590	493	436	377	309	304
GENEVA	570	555	459	464	517	529	568

Figure 13 A mileage chart for a European tour (answer)

The distance between Florence and Calais is 860 miles.

Now try the following activity.

Activity 9: A European journey

Now answer the following questions using Figure 12.

1. Which port is closest to Florence?
2. How far is it from Cologne to Dieppe?
3. If you were staying in in Amsterdam, which would be your closest port?

.....

Answer

1. The closest to Florence is Zeebrugge (821 miles).
2. The distance between Cologne and Dieppe is 328 miles.
3. If you were staying in Amsterdam, the closest port would be Hook of Holland (53 miles).

2.1 Adding distances

Many trips have more than one stop. To calculate how far you have to travel you need to add together the distances between stops.

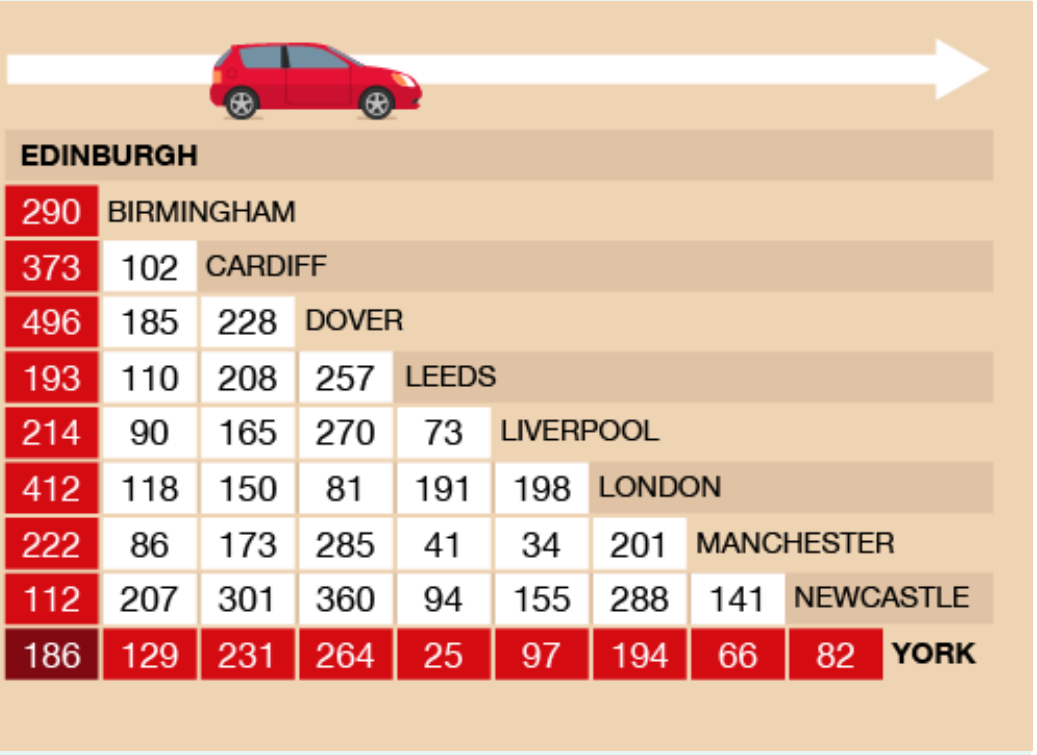
Example: The sales trip

A sales rep has to travel from Edinburgh to York, then to London, and then back to Edinburgh. How far will they travel?

Method

Use the mileage chart to find the distances between Edinburgh and York, York and London, and London and Edinburgh.

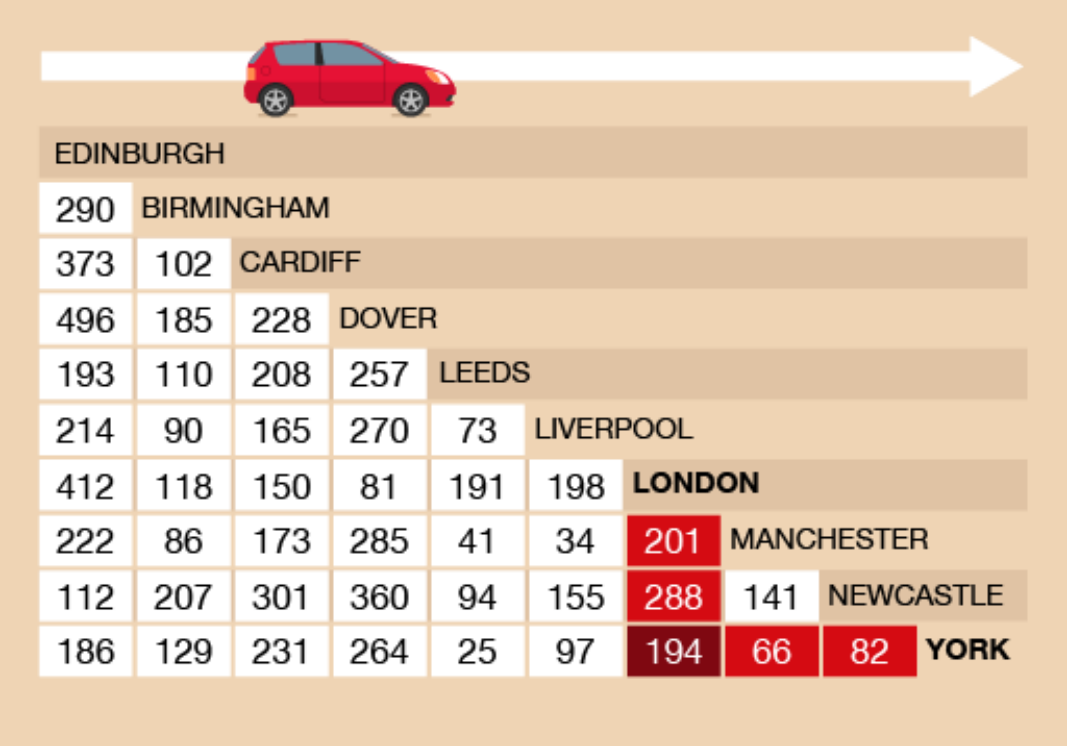
The distance between Edinburgh and York is 186 miles.



EDINBURGH								
290	BIRMINGHAM							
373	102	CARDIFF						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	LIVERPOOL			
412	118	150	81	191	198	LONDON		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 YORK

Figure 14 Edinburgh to York on a mileage chart

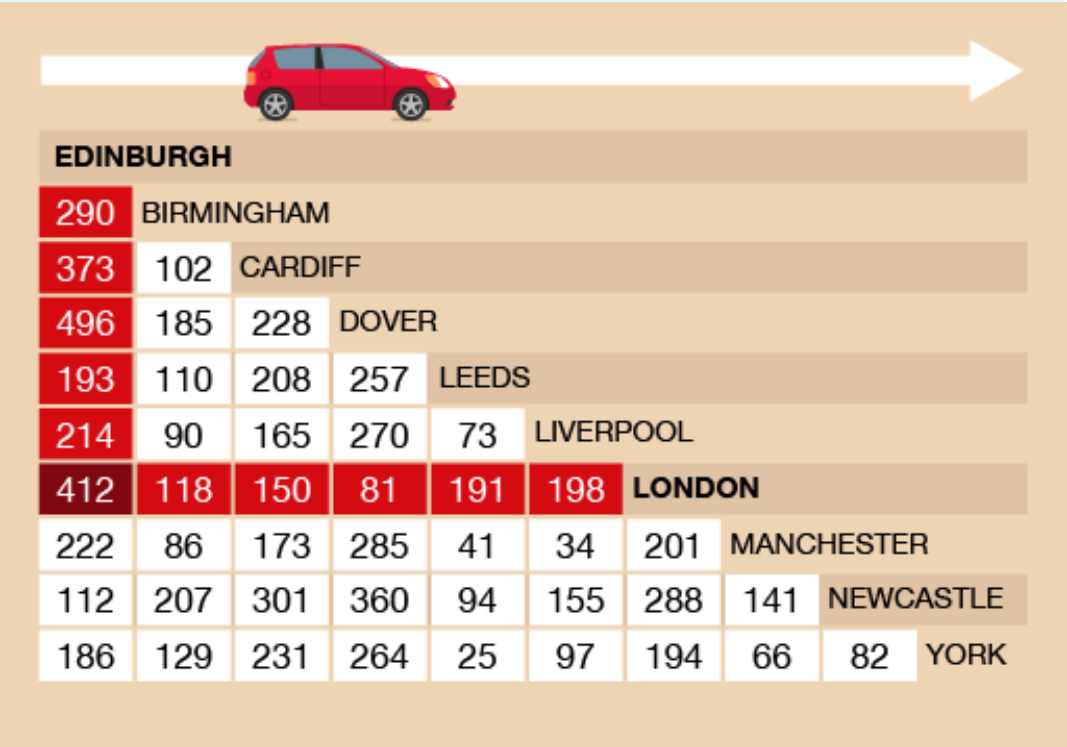
York to London is 194 miles.



EDINBURGH								
290	BIRMINGHAM							
373	102	CARDIFF						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	LIVERPOOL			
412	118	150	81	191	198	**LONDON**		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 **YORK**

Figure 15 London to York on a mileage chart

Returning from London to Edinburgh is 412 miles.



EDINBURGH								
290	BIRMINGHAM							
373	102	CARDIFF						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	LIVERPOOL			
412	118	150	81	191	198	**LONDON**		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 YORK

Figure 16 London to Edinburgh on a mileage chart

The total distance of the trip is:

186 + 194 + 412 = 792 miles

Use the mileage table to help you with the following activity. Pleasemake the calculations without using a calculator. You may double-check your answer with a calculator if you need to. Remember to check your answers once you have completed the questions.

Activity 10: Travelling across the UK

1. You use a hire car to go from London to Cardiff, from Cardiff to Liverpool and then back to London. You pay 10p for each mile you drive.
   a. How many miles must you pay for?
   b. How much would this cost?
2. You live Cardiff but are going to attend a conference in Manchester. Following your conference, you are driving straight on to York to stay for a few days before returning home to Cardiff. How far will your journey be in total?

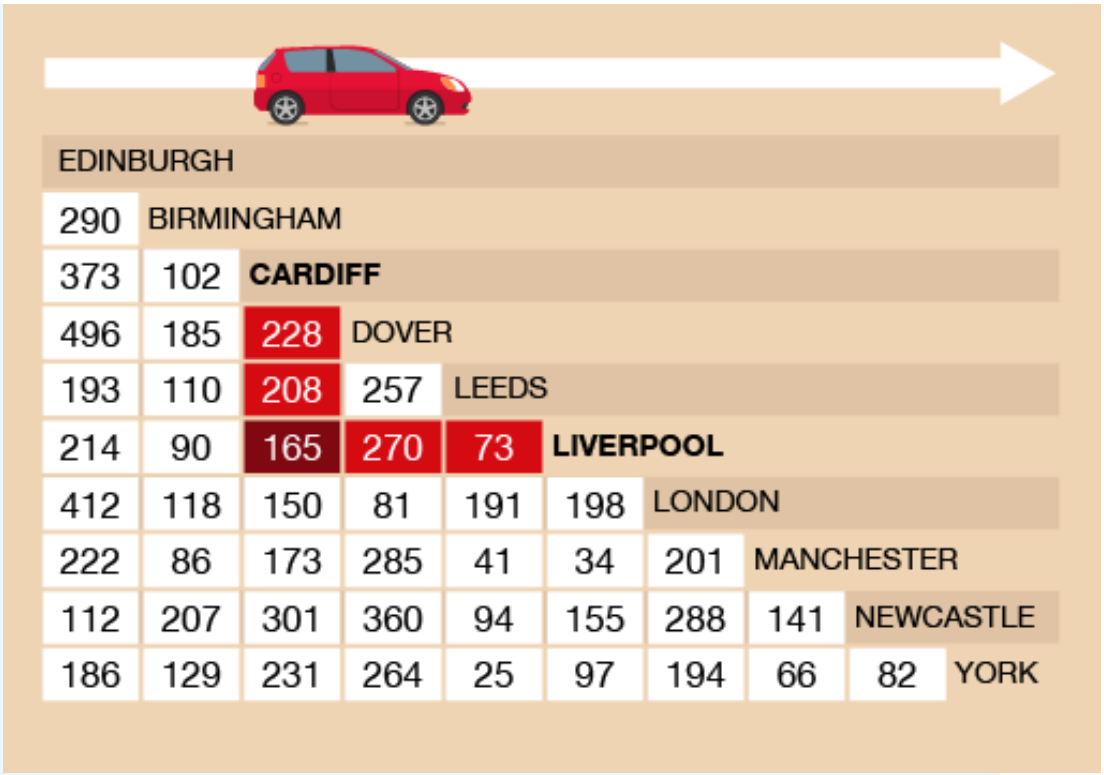
Answer

1. The answers are as follows:
   a. You need to look up all the distances and then add them together: London to Cardiff is 150 miles.

EDINBURGH								
290	BIRMINGHAM							
373	102	**CARDIFF**						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	LIVERPOOL			
412	118	150	81	191	198	**LONDON**		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 YORK

Figure 17 London to Cardiff on a mileage chart

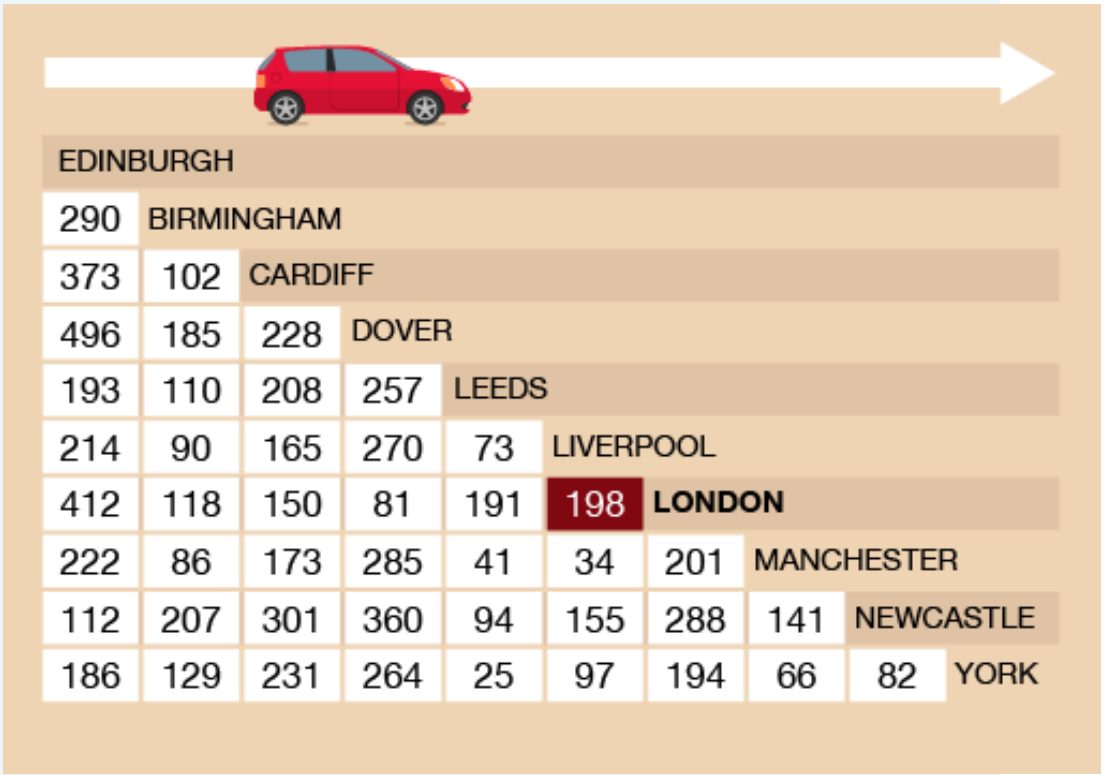
Cardiff to Liverpool is 165 miles.



EDINBURGH								
290	BIRMINGHAM							
373	102	**CARDIFF**						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	**LIVERPOOL**			
412	118	150	81	191	198	LONDON		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 YORK

Figure 18 Cardiff to Liverpool on a mileage chart

Liverpool to London is 198 miles.



EDINBURGH								
290	BIRMINGHAM							
373	102	CARDIFF						
496	185	228	DOVER					
193	110	208	257	LEEDS				
214	90	165	270	73	LIVERPOOL			
412	118	150	81	191	198	**LONDON**		
222	86	173	285	41	34	201	MANCHESTER	
112	207	301	360	94	155	288	141	NEWCASTLE
186	129	231	264	25	97	194	66	82 YORK

Figure 19 Liverpool to London on a mileage chart

So the total distance is:

150 + 165 + 198 = 513 miles

b. The total distance is 513 miles and you pay 10p for each mile you drive. So you would pay:

513 × 10 = 5 130p

You would not usually express an amount of money in this way, so let's divide this total by 100 to find the amount in pounds:

5 130 ÷ 100 = £51.30

2. You need to look up all the distances and then add them together. Cardiff to Manchester is 173 miles; Manchester to York is 66 miles; and York to Cardiff is 231 miles. So the total distance is:

173 + 66 + 231 = 470 miles

Summary

You have now completed the activities on using distance charts. This will help you with everyday life when you are planning a journey and/or claiming mileage when travelling for work.

2.2 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.

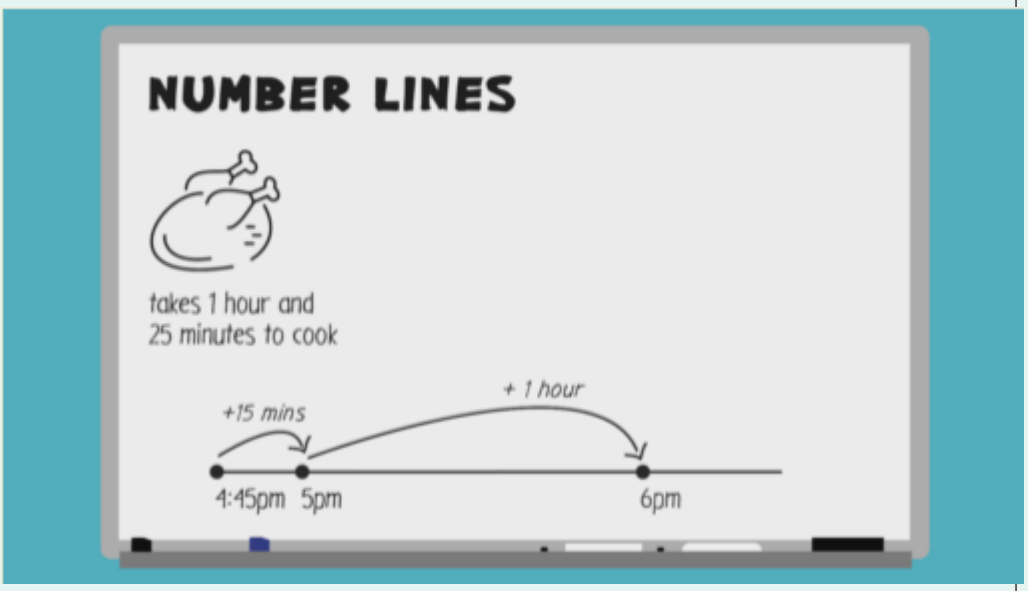
Example: Cooking

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 20 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 meet 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 2(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 2(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 2(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).

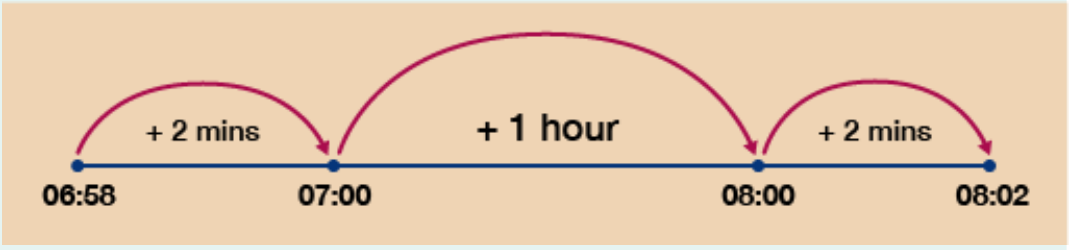


Figure 21 A number line for a timetable

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

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

Activity 11: 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 3(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:

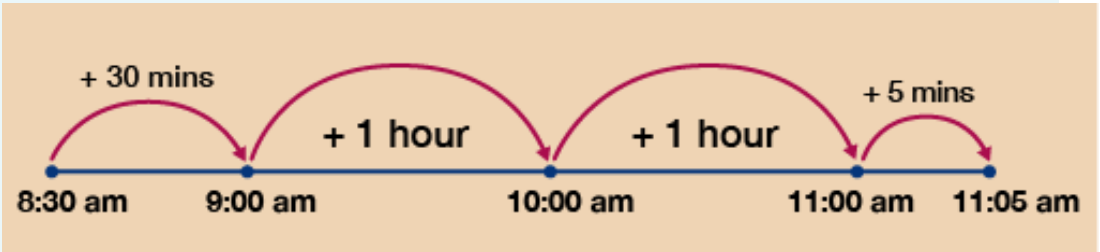


Figure 22 A number line for Question 1

So Kacper arrives at work at 11:05 am.

You could also do the calculation by adding on the 1 hour 45 minutes first:

8:30 am + 1 hour = 9:30 am
9:30 am + 45 minutes = 10:15 am

Finally, you can add on the 50 minutes:

10:15 am + 45 minutes = 11:00 am

Then add on the remaining 5 minutes:

11:00 am + 5 minutes = 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.

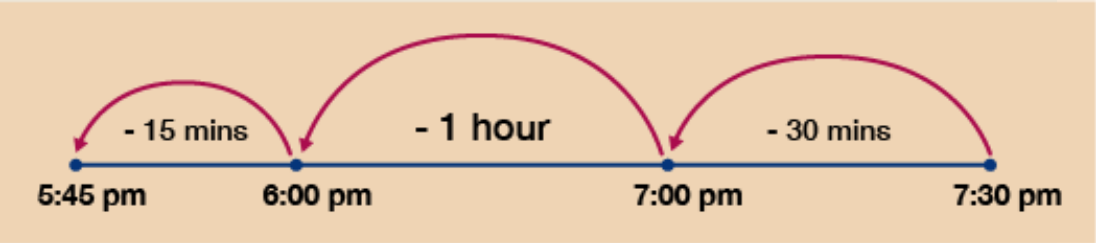


Figure 23 A number line for Question 2

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

As with the first question, you could have done this question by taking off each stage in the cooking process separately rather than finding the total time first:

7:30 pm − 20 minutes = 7:10 pm
7:10 pm − 1 hour = 6:10 pm

There are 25 minutes left so:

6:10 pm − 10 minutes = 6:00 pm

There are now 15 minutes left so:

6:00 pm − 15 minutes = 5:45 pm

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 3(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).

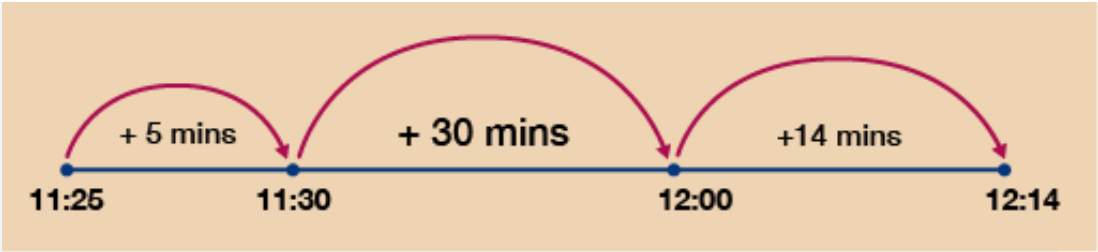


Figure 24 A number line for Question 3

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

Summary

You have now completed the activities on using distance charts. This will help you with everyday life when you are planning a journey and/or claiming mileage when travelling for work.

3 Using metric measurements: weight

Weight – sometimes referred to as ‘mass’ – is a measurement of how heavy something is.

How much do you weigh?

You might have given your weight in kilograms (kg) or in pounds (lb), or pounds and stone (st). Kilograms are metric weights. Pounds and stones are imperial weights.

In the UK, both metric and imperial units may be used. We are going to focus on the metric units of weight here.

Metric units of weight

Metric unit	Abbreviation
milligram	mg
gram	g
kilogram	kg
tonne	(No abbreviation)

Milligrams (mg) are only used to weigh very small quantities or items, such as dosage on medication.

A tonne is a unit for weighing very heavy items, such as a lorry.

For everyday measuring tasks, the most common metric units of weight are grams (g) and kilograms (kg), so these are what you will focus on here.

1 g is approximately the weight of a paperclip

1 kg is the weight of a bag of sugar

Key fact: 1 000 grams (g) = 1 kilogram (kg)

Hint: If you are used to using the imperial system of measure, 1kilogram is equivalent to about $2\frac{1}{4}$ pounds.

Many foods are sold by weight. For example:

- 10 g of a spice
- 30 g of crisps
- 100 g of chocolate
- 250 g of coffee
- 500 g of rice.

Heavier things are weighed in kilograms:

- 2 kg bag of potatoes
- 10 kg of chicken food
- 15 kg baggage allowance on a plane
- 25 kg bag of cement.

Note that if you bought ten packets of rice, you would say you had bought 5 kg rather than 5 000 g.

3.1 Instruments of measure

Scales show you how much something weighs. Digital scales show the weight as a display of numbers. Other scales have a dial or line of numbers and you have to read the weight from this.

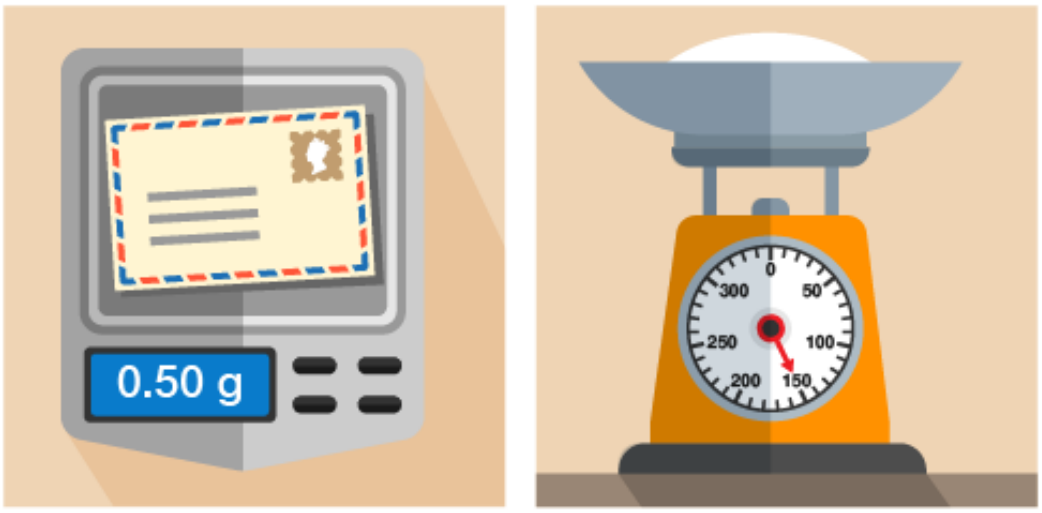


Figure 25 Using different scales for different objects

You'll notice that on the right-hand set of scales in the picture above, the needle points to 150 g. If you use scales like this, you need to know the divisions marked on the scales. You might have to count the marks between numbers.

Example: Identifying weights on scales

What is the weight of the flour in these scales?

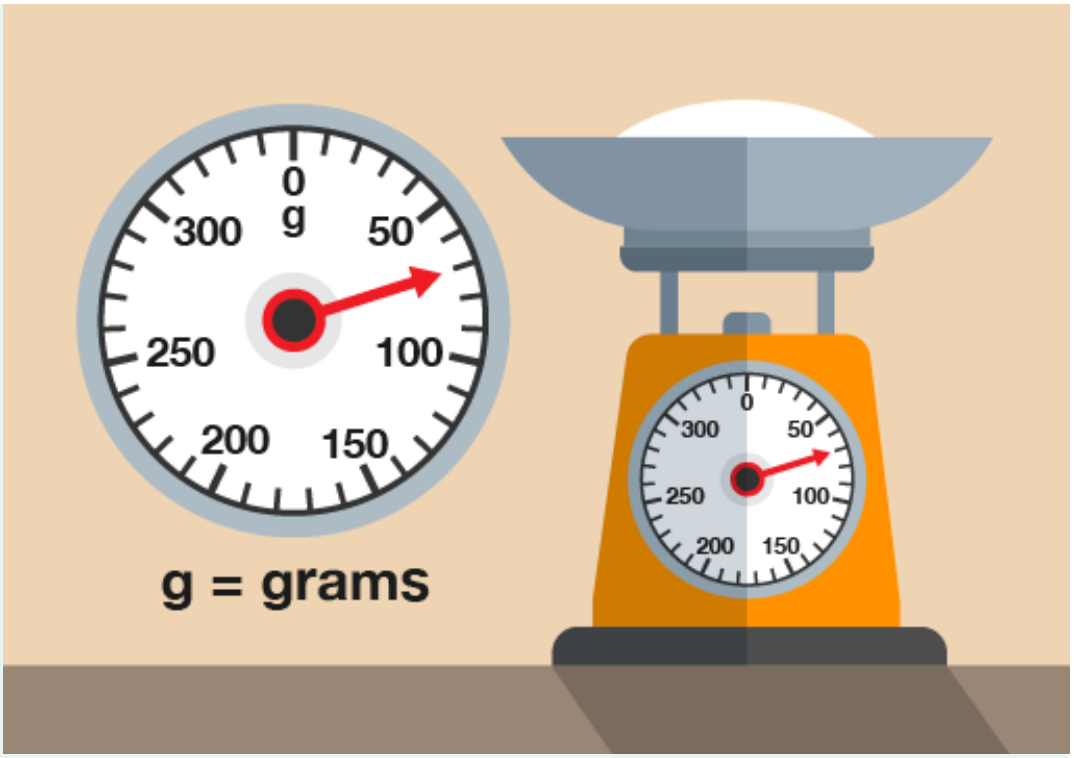


Figure 26 Weighing flour

(Note that scales like this are calibrated to weigh only the flour inside the bowl – the weight on the scales is just the flour, not the flour and the bowl.)

Method

There are four marks between 50 g and 100 g, each representing another 10 g. So the marks represent 60 g, 70 g, 80 g and 90 g. The needle is level with the second mark, so the weight is 70 g.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 12: Reading scales

1. How many grams of sugar are on the scales in the picture below?

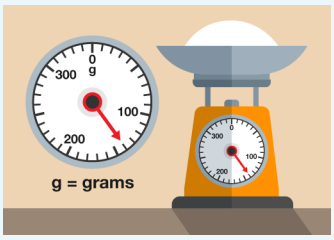


Figure 27 Weighing sugar

2. What is this person's weight in kilograms?

Figure 28 Weighing a person

3. How much does the letter weigh?

Figure 29 Weighing a letter

Answer

1. There are nine marks between 100 g and 200 g, so each mark represents 10 g. The needle is at the fourth mark after 100g, so there is:

   100 + 40 = 140 g of sugar

2. The needle is halfway between 60 kg and 70 kg, so the person weighs 65 kg.
3. There are nine marks between 0 g and 100 g, so there's a mark at every 10 g. The needle is two marks before 100 g, so the letter weighs:

   100 – 20 = 80 g

3.2 Weighing things

It's useful to have an idea of how much things weigh. It can help you to work out the weight of fruit or vegetables to buy in a market, for example, or whether your suitcase will be within the weight limit for a flight.

Try estimating the weight of something before you weigh it. It will help you to get used to measures of weight.

Hint: Remember to use appropriate units. Give the weight of small things in grams and of heavy things in kilograms.

Remember that:

- 1 g is approximately the weight of a paperclip.
- 1 kg is the weight of a bag of sugar.
- 1 kg = 1 000 g

Take a look at the example below before having a go at the activity.

Example: Weighing an apple

1. Which metric unit would you use to weigh an apple?
2. Estimate how much an apple weighs and then weigh one.
3. How much would 20 of these apples weigh? Would you use the same units?

Method

1. An apple is quite small, so it should be weighed in grams.
2. How much did you estimate that an apple weighs? A reasonable estimate would be 100 g.

   When we weighed an apple, it was 130 g.
3. Twenty apples would weigh:

   $130 \times 20 = 2\,600$ g

   This answer could also be expressed in kilograms. To convert from grams to kilograms, you need to divide the figure in grams by 1 000 (1 kg = 1 000 g) . So the weight of the apples in kilograms is:

   $2\,600 \text{ g} \div 1\,000 = 2.6$ kg

We will look more at converting metric units of weight in the next section.

Activity 13: Weighing things

1. How much do ten teabags weigh? Estimate and then weigh them.
2. How heavy is a bottle of sauce? How much would a case of 10 bottles weigh?

Hint: The weight shown on the label is the weight of the sauce – it doesn't include the weight of the bottle or jar that the sauce comes in. So for an accurate measurement, you need to weigh the bottle rather than read the label!

3. How heavy is a book?

Discussion

Our suggestions are shown in the table below. Your estimates and measured weights might be different, but they should be roughly similar.

Item	Estimated weight	Actual weight
Ten teabags	25 g	30 g
Bottle of sauce	500 g	450 g
Book	900 g	720 g

A case of ten bottles of sauce would weigh:

$$450 \times 10 = 4\,500 \text{ g}$$

As previously noted, 1 000 g = 1 kg, so 4 500 g = 4.5 kg, which is how you would more usually express this weight.

If your book weighed more than ours, you might have given its weight in kilograms. If you chose a small book, it may have weighed a lot less.

3.3 Converting metric units of weight

There are occasions where you may have to convert between metric units of weight. Figure 30 shows you how to do this. In this section, we are only going to practise converting between grams (g) andkilograms (kg).

Hint: Weight is sometimes referred to as mass.

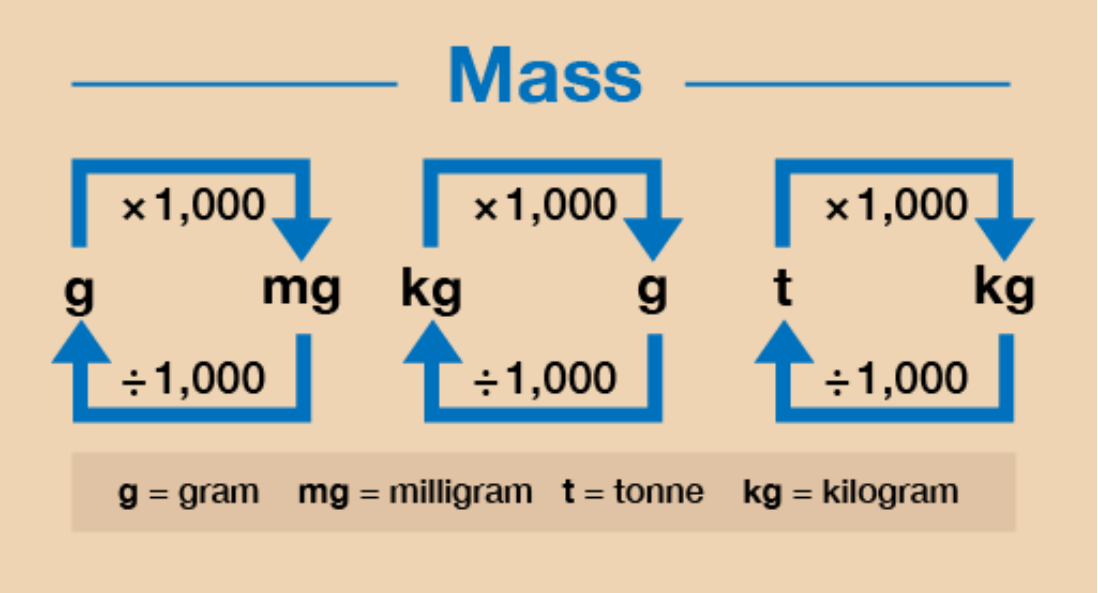


Figure 30 A conversion chart for weight

Example: Converting units of weight

1. Convert the following from kilograms into grams:
   a. 4 kg = ? g
   b. 6.5 kg = ? g
2. Convert the following from grams into kilograms:
   a. 8 000 g = ? kg
   b. 1 250 g = ? kg

Method

1. As you can see from Figure 30, to convert from kilograms (kg) to grams (g) you need to multiply by 1 000:
   a. 4 kg × 1 000 = 4 000 g
   b. 6.5 kg × 1 000 = 6 500 g
2. If you want to convert from grams (g) to kilograms (kg) you need to divide by 1 000:
   a. 8 000 g ÷ 1 000 = 8 kg
   b. 1 250 g ÷ 1 000 = 1.25 kg

Now try the following activity.

Activity 14: Converting metric units of weight

Calculate the following without using a calculator. You may wish to look back at Session 1 to remind you how to multiply and divide by 1 000.

You may double-check your answer with a calculator if you need to. Remember tocheck your answers.

1. Convert the following to kilograms:
   a. 3 000 g
   b. 9 500 g
   c. 750 g
   d. 10 000 g
2. Convert the following to grams:
   a. 4 kg
   b. 1.5 kg
   c. 7.6 kg
   d. 2.25 kg

Answer

1. The answers are as follows:
   a. 3 000 g ÷ 1 000 = 3 kg
   b. 9 500 g ÷ 1 000 = 9.5 kg
   c. 750 g ÷ 1 000 = 0.75 kg
   d. 10 000 g ÷ 1 000 = 10 kg
2. The answers are as follows:
   a. 4 kg × 1 000 = 4 000 g
   b. 1.5 kg × 1 000 = 1 500 g
   c. 7.6 kg × 1 000 = 7 600 g
   d. 2.25 kg × 1 000 = 2 250 g

3.4 Calculate using metric units of weight

You may need to carry out other calculations with weight. This may require you to convert between metric units, either before you carry out the calculation or at the end.

Example: Weight of ingredients

If you were to buy 750g of flour, 500g of sugar and 250g of butter, what is the total weight of these ingredients in kilograms?

Method

As all of the measurements are given in grams, you can add them together:

750 g + 500 g + 250 g = 1 500 g

The question asks for the final weight in kilograms. Knowing that 1 kilogram equals 1 000 grams, you now need to convert the amount in grams:

1 500 ÷ 1 000 = 1.5 kg

Example: A block of cheese

A deli has a 1.4 kg block of cheese. Three pieces, each weighing 250 g, are cut from it. How much does the remaining block of cheese weigh?

Method

The main block of cheese is 1.4 kg, so you need to convert this into grams:

1.4 kg × 1 000 = 1 400 g

The three pieces of cheese weigh:

250 g × 3 = 750 g

Taking this away from the original weight of the block of cheese gives you the answer:

1 400 g – 750 g = 650 g

Now try the following activity.

Activity 15: Carrying out calculations with weight

Calculate the answers to the following problems without using a calculator. You may wish to look back at Session 1 to remind you about how to carry out calculations with whole numbers and decimals.

You may double-check your answers with a calculator if you need to. Remember to check your answers.

1. Lily is making 3 kg of jam. The jam is made up of fruit and sugar. The weight of the fruit is 1 kg 800 g. How much sugar should she add to make the 3 kg of jam?
2. Three parcels weigh 1.25 kg, 3.5 kg and 600g. What is the total weight of the parcels in kilograms?
3. The hand luggage allowance is 7 kg for a particular airline. If you buy a cabin bag that weighs 3.1 kg, what is the maximum weight that you can pack?
4. A puppy weighs 2.3 kg at seven weeks old. It puts on 800 g a week. How much will it approximately weigh at ten weeks old?

Answer

1. You need to decide whether to convert everything into grams or kilograms first. Using Method 1, converting everything into grams, the total weight of the jam in grams will be:

   3 kg × 1 000 = 3 000 g

The weight of the fruit is:

1 kg × 1 000 = 1 000 g + 800 g = 1 800 g

Now you can take the weight of the fruit away from the total weightneeded:

3 000 g – 1 800 g = 1 200 g

If needed, you can convert to kilograms:

1 200 g ÷ 1 000 = 1.2 kg

Using Method 2, expressing the weight of the fruit in kilograms, the weight of the fruit is 1 kg 800 g, which is 1.8 kg. If you take the weight of the fruit away from the total weight of the jam needed, the answer is:

3 kg – 1.8 kg = 1.2 kg

2. You need to decide whether to convert everything into grams orkilograms first. Using Method 1, converting everything to grams first:

   Parcel 1: 1.25 kg × 1 000 = 1 250 g

   Parcel 2: 3.5 kg × 1 000 = 3 500 g

   Parcel 3: 600g

Add the weights of the parcels in grams:

1 250 g + 3 500 g + 600 g = 5 350 g

The question wants the answer in kilograms, you will need to convert:

5 350 g ÷ 1 000 = 5.35 kg

Using Method 2, converting everything to kilograms first:

Parcel 1: 1.25 kg

Parcel 2: 3.5 kg

Parcel 3: 600 g ÷ 1 000 = 0.6 kg

Add the weights of the parcels in kilograms:

1.25 kg + 3.5 kg + 0.6 kg = 5.35 kg

3. If the maximum hand luggage is 7 kg and the case weighs 3.1 kg, then you can pack the following amount without going over the maximum limit:

   7 kg – 3.1 kg = 3.9 kg

You may have worked this out in grams:

Maximum weight: 7 kg × 1 000 g = 7 000 g

Weight of case: 3.1 kg × 1 000 = 3 100 g

Amount of luggage: 7 000 g – 3 100 g = 3 900 g

4. To work out the answer, convert the puppy's weight at seven weeks into grams first:

   2.3 kg × 1 000 = 2 300 g

The puppy puts on 800 g a week:

Week 8: 2 300 g + 800 g = 3 100 g

Week 9: 3 100 g + 800 g = 3 900 g

Week 10: 3 900 g + 800 g = 4 700 g

You may want to express you answer in kilograms:

4 700 g ÷ 1 000 = 4.7 kg

Summary

In this section you have learned how to:

- estimate and measure weight
- use metric units of weight
- know the relationship between grams and kilograms
- convert between grams and kilograms
- calculate using metric weights.

4 Capacity

Capacity (sometimes referred to as volume) is a measurement of how much space something takes up.

When you buy milk, how much is in each bottle or carton? What about when you buy juice?

Most people buy milk in cartons or bottles of one, two, four or six pints. Juice is usually sold in cartons or bottles of one litre.

Pints are an imperial measure of volume, and litres are a metric measure of volume. A litre is slightly less than two pints. We are going to focus on metric units here.

Metric units of length

Metric unit	Abbreviation
millilitre	ml
centilitre	cl
litre	l

You sometimes see capacity marked in centilitres (cl), such as on the side of a bottle of water, where the measurement may be shown as 50 cl or 500 ml. However, the most common metric units of capacity are millilitres and litres, so these are what we will focus on here.

Key fact: One litre (1 l) is the same as 1 000 millilitres (1 000 ml).

4.1 Instruments of measure

To measure a very small amount, you might use a teaspoon. This is the same as 5 millilitres (ml).

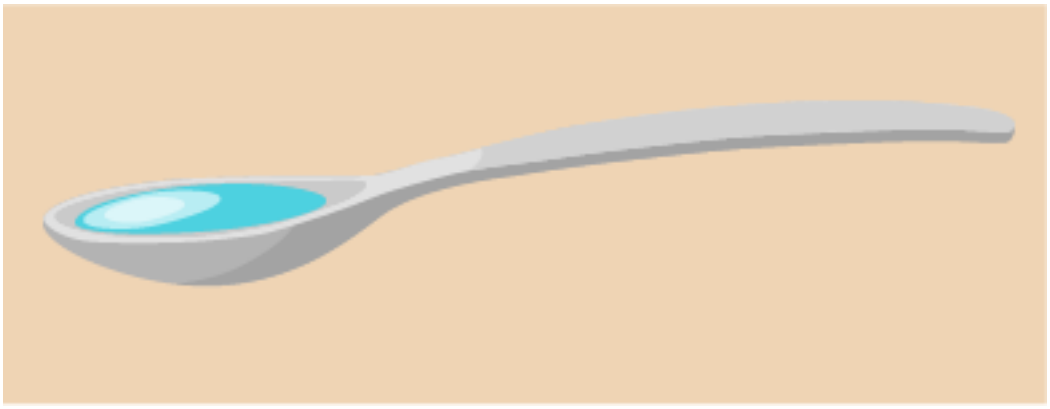


Figure 31 A teaspoon

To measure larger amounts, you would probably use a measuring jug of some kind. Measuring jugs are often labelled in millilitres, especially newer ones, and they can come in different sizes: some can measure up to 500 ml of liquid and others up to 1 litre (1 000 ml). Some may hold more or less than this.

Figure 32 A measuring jug

Now take a look at the following example.

Example: Measuring liquids

If you had to measure out 350 ml of juice for a recipe, where would the liquid come to in this jug?

Figure 33 Measuring liquids in a measuring jug

Method

There are three marks on the jug between 300 ml and 400 ml. These mark 325, 350 and 375 ml. So you need to fill the jug to the middle mark (remember to look for the

level where the liquid touches the scale). You may have to hold a jug up to eye level to measure the amount as accurately as you can.

Figure 34 Measuring liquids in a measuring jug (answer)

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 16: Looking at capacity (volume)

Now that you have seen the example, have a go at the following activity;

1. How much coffee or tea does a cup you usually drink out of hold? Estimate the volume first, and write down your estimate. Next, fill your cup with water and then pour the water into a measuring jug. (**Hint:** A standard bottle of water holds 500 ml. A can of of pop is 330 ml.)
2. A scientist has to measure 2.8 ml of liquid in this syringe. Where should the liquid come to?

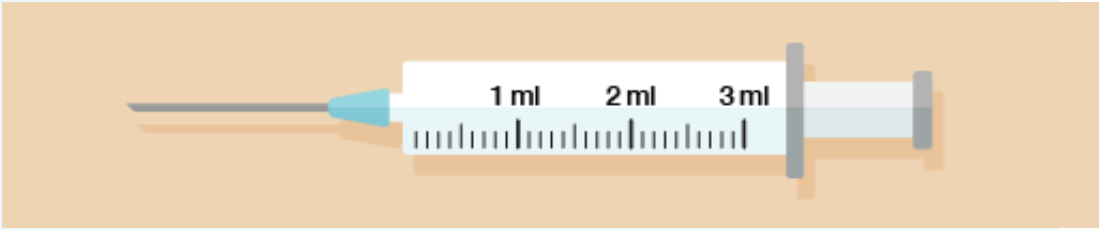


Figure 35 A syringe

3. A plumber has drained water from a faulty central heating system into a set of measuring jugs. How many litres in total has the plumber drained from the system? Notice how on these measuring jugs, the scale is marked up in fractions of a litre rather than in millilitres.

Figure 36 Three measuring jugs

Answer

1. I estimated that my cup holds 400 ml. It actually holds 350 ml. Youranswer may be quite different to this, depending on the size of the cup.
2. The divisions are marked every 0.1 ml. The syringe should look like this:

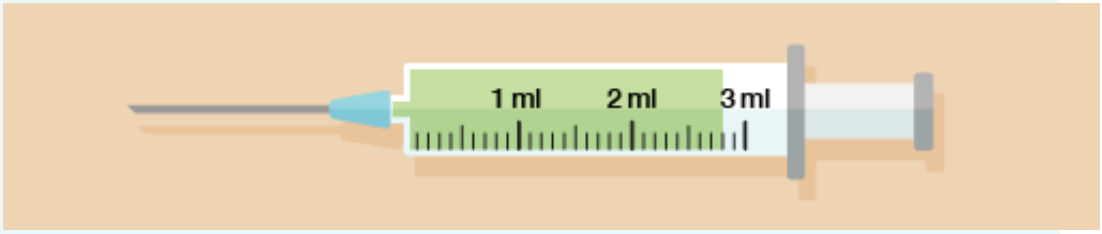


Figure 37 A syringe (answer)

3. The plumber has drained two full one-litre jugs and three-quarters of another jug, making 2.75 litres in total. This could also be written as 2 750 ml or 2 litres 750 ml.

4.2 Converting metric units of capacity

You will sometimes need to change between millilitres and litres. There are 1 000 millilitres in a litre.

Take a look at this metric conversion chart to refer to when you are carrying out the activity below.

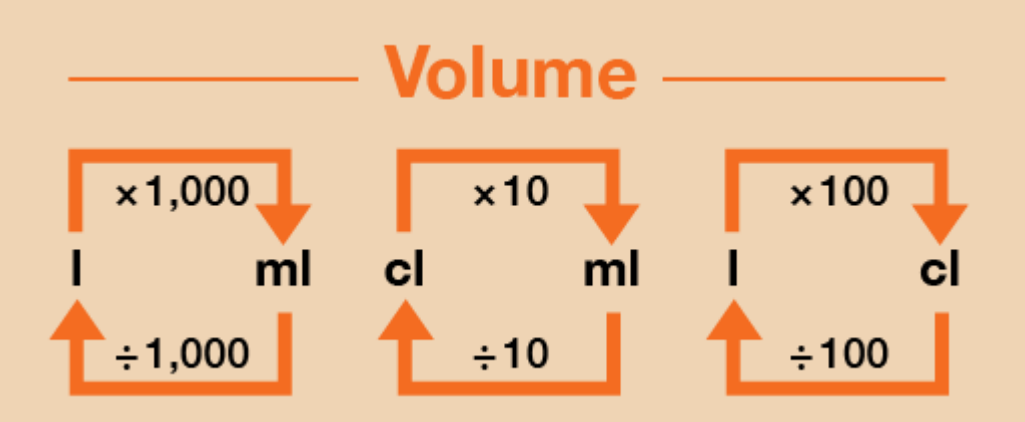


Figure 38 A conversion chart for volume

As mentioned earlier, capacity/volume can be measured in centilitres (cl), but it is more common to use millilitres (ml) and litres (l), so we will focus on converting between these here.

Example: Converting units of capacity

1. Convert the following from litres into millilitres:
   a. 7 litres = ? ml
   b. 8.5 litres = ? ml
2. Convert the following from millilitres into litres:
   a. 6 000 ml = ? litres
   b. 2 750 ml = ? litres

Method

1. As you can see from Figure 38, to convert from litres (l) to millilitres (ml), you need to multiply by 1 000:
   a. 7 l × 1 000 = 7 000 ml
   b. 8.5 l × 1 000 = 8 500 ml
2. If you want to convert from millilitres (ml) to litres (l) then you need todivide by 1 000:
   a. 6 000 ml ÷ 1 000 = 6 l
   b. 2 750 ml ÷ 1 000 = 2.75 l

Now try the following activity.

Activity 17: Converting metric units of capacity

Calculate the following without using a calculator. You may wish to look back at Session 1 to remind you how to multiply and divide by 1 000. Remember to check your answers.

1. What are the following measurements in litres?
   a. 4 000 ml
   b. 3 500 ml

c. 650 ml
d. 8 575 ml

2. What are the following measurements in millilitres?
   a. 9 litres
   b. 2.5 litres
   c. 4.8 litres
   d. 8.95 litres

Answer

1. The answers are as follows:
   a. 4 000 ml ÷ 1 000 = 4 litres
   b. 3 500 ml ÷ 1 000 = 3.5 litres
   c. 650 ml ÷ 1 000 = 0.65 litres
   d. 8 575 ml ÷ 1 000 = 8.575 litres
2. The answers are as follows:
   a. 9 litres × 1 000 = 9 000 ml
   b. 2.5 litres × 1 000 = 2 500 ml
   c. 4.8 litres × 1 000 = 4 800 ml
   d. 8.95 litres × 1 000 = 8 950 ml

4.3 Calculate using metric units of capacity

You may need to carry out calculations involving capacity. This may require you to convert between metric units, either before you carry out the calculation or at the end.

Example: Party food

You are cooking for a large party. The recipe you are using calls for 600 ml of milk to make enough for four people.

How many litres of milk will you need to make ten times as much?

Method

First you need to multiply the amount in millilitres by 10:

600 × 10 = 6 000 ml

However, the question asks for an amount in *litres*, not millilitres. To convert from millilitres to litres, you need to divide the figure in millilitres by 1 000. So the amount of milk you need in litres is:

6 000 ÷ 1 000 = 6 litres

Now try the following activity using the conversion diagram on the previous page to help you answer the questions. Remember to check your answers once you have completed the questions.

Activity 18: Carrying out calculations involving capacity

Calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers.

1. A nurse has to order enough soup for 100 patients on a ward. Each patient will eat 400 ml of soup. How many litres of soup must the nurse order?
2. Twenty people working in a craft workshop have to share the last two-litre bottle of glue. How many millilitres of glue can each person use? What would this be in centilitres?
3. Willow buys a two-litre carton of milk. She measures out 350 ml for a sauce, 25 ml for a cake and 100 ml for her toddler's bedtime drink. How much milk is left in the carton? Express your answerin millilitres.
4. Ben is having a party and he wants to make a non-alcoholic cocktail. He has found a recipe which states that he needs 500 ml of cranberry juice, 500 ml of grape juice, 250 ml of orange juiceand 1 litre of sparkling water to serve eight people. There will be 24 people at the party.

   How much of each ingredient will he need? Express your answers in litres.

   Will an eight-litre drinks dispenser be big enough to hold his non-alcoholic cocktail?

Answer

1. First you need to work out how much soup you will need in millilitres:

   100 × 400 = 40 000 ml

   To convert from millilitres to litres, you need to divide the figure in millilitres by 1 000. So the amount of milk you need in litres is:

   40 000 ÷ 1 000 = 40 litres
2. First you need to work out how many millilitres are in 2 litres of glue:

   2 × 1 000 = 2 000 ml

   This amount is then divided between the twenty people working in the shop:

   2 000 ÷ 20 = 100 ml each

   To convert this into centilitres, you would divide this answer by 10:

   100 ÷ 10 = 10 cl each
3. First add together the amount of milk Willow has used:

   350 ml + 25 ml + 100 ml = 475 ml

   The carton holds two litres, which in millilitres is:

   2 litres × 1 000 = 2 000 ml

   Now take the amount used away from the amount the carton holds:

   2 000 ml – 475 ml = 1 525 ml

   So 1 525 ml is left in the carton.
4. The quantities stated are enough to make the drink for eight people. If 24 people are invited to the party, Ben will need three times as much ingredients as stated in the recipe (8 × 3 = 24). So he will need:

   500 ml × 3 = 1 500 ml of cranberry juice (1 500 ÷ 1 000 = 1.5 litres)

   500 ml × 3 = 1 500 ml of grape juice (1 500 ÷ 1 000 = 1.5 litres)

   250 ml × 3 = 750 ml of orange juice (750 ÷ 1 000 = 0.75 litres)

1 litre × 3 = 3 litres of sparkling water (this is already in litres, so no conversion is needed)

To see if the bowl will be big enough, we need to add the quantities expressed in litres together:

1.5 litres + 1.5 litres + 0.75 litres + 3 litres = 6.75 litres

So the eight-litre drinks dispenser will be big enough.

Summary

In this section you have learned how to:

- identify the standard units for measuring volume or capacity
- measure volumes
- convert between metric units of capacity
- carry out calculations with metric units of capacity.

5 Measuring temperature

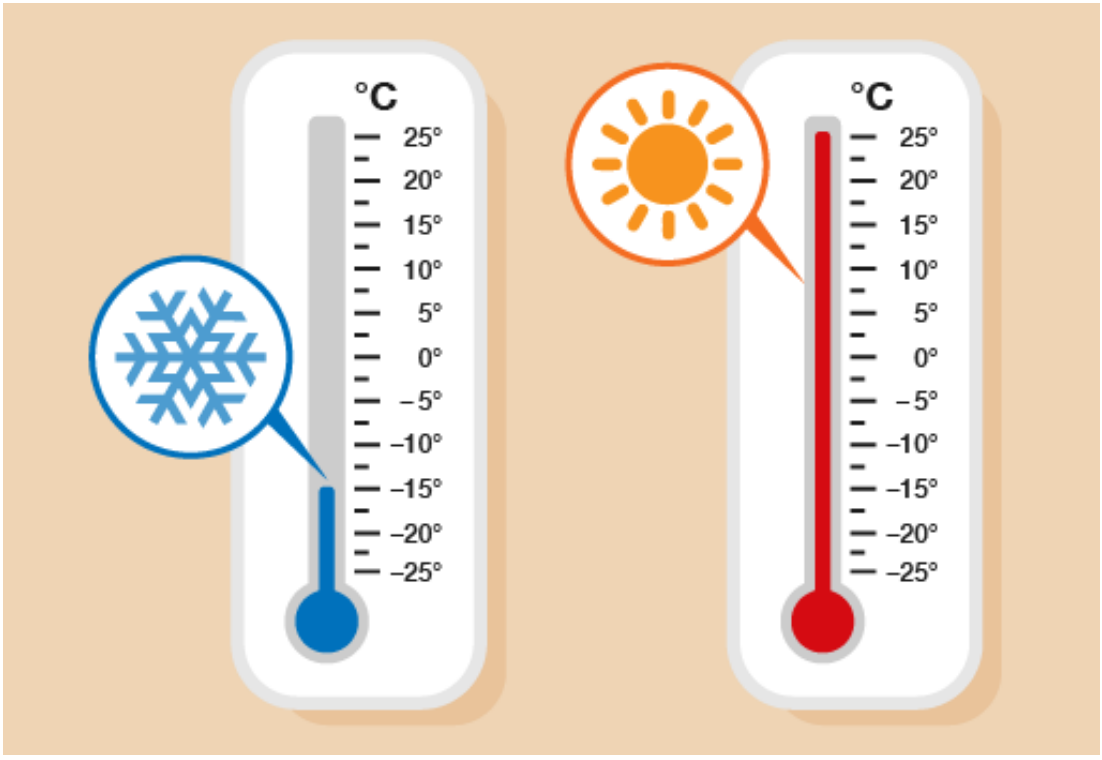


Figure 39 Comparing temperatures

Temperature tells us how hot or cold something is. You will see or hear temperatures mentioned in a weather forecast, and will also come across them in recipes or other instructions.

Temperature is sometimes given in degrees Celsius (°C) and sometimes in degrees Fahrenheit (°F).

Hint: You might sometimes see Celsius called ‘centigrade’. Note that Celsius and centigrade are the same thing, referring to the same scale of measurement.

Water freezes at 0° Celsius and boils at 100° Celsius. The temperature in the UK in the daytime is usually between 0° Celsius (0°C) on a cold winter’s day and 25° Celsius on a hot day in summer.

5.1 Reading temperatures

Many things have to be stored or used in a particular temperature range to be safe. Temperature is measured with a **thermometer**.

Thermometers for different uses show different ranges of temperatures.

Take a look at the following example, which shows two types of thermometer.

Example: Reading thermometers

What is the temperature shown on each thermometer below?

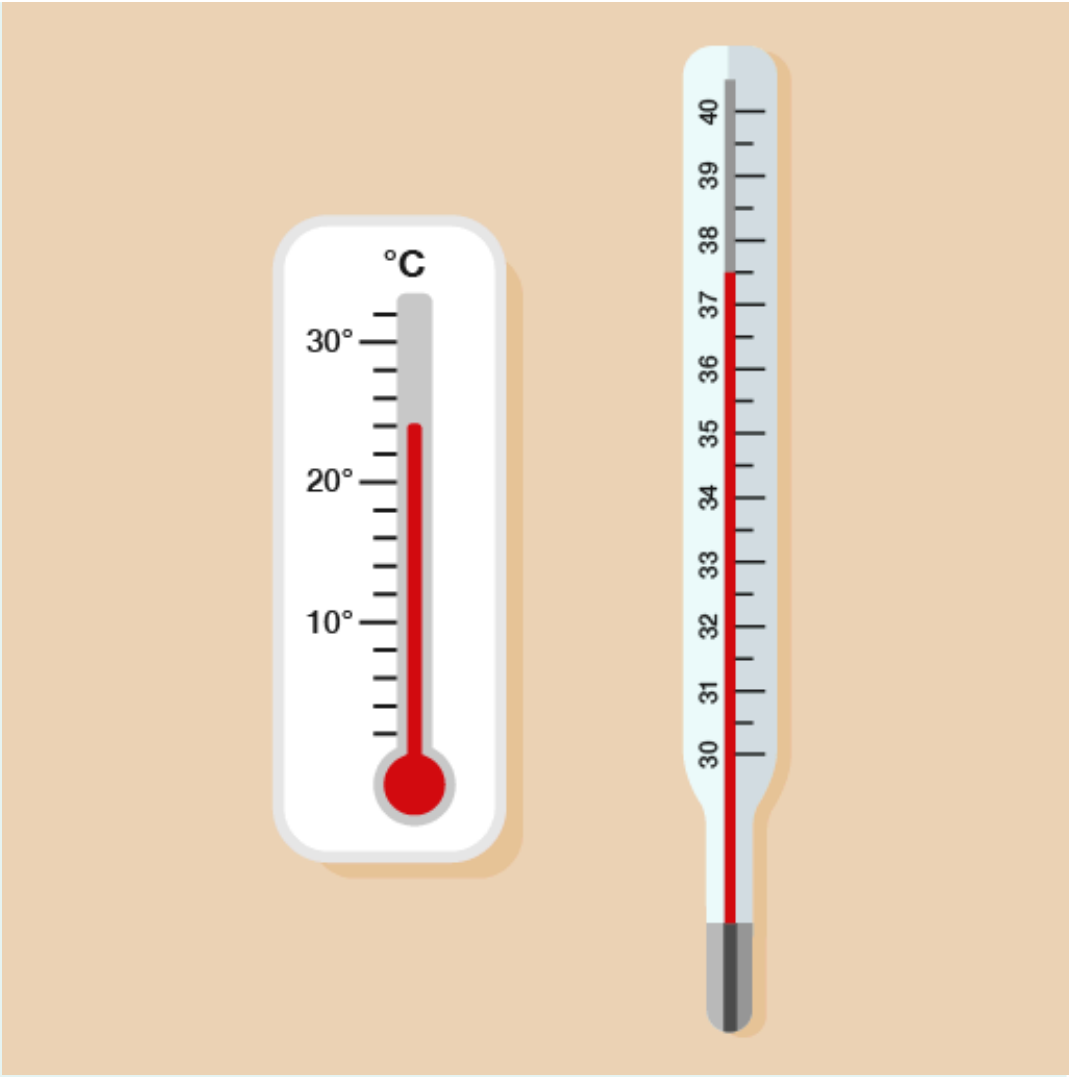


Figure 40 Reading the temperatures

Method

On the first thermometer, there are four divisions between 20 and 30, so the divisions mark every two degrees (22, 24, 26, 28). The reading is at the second mark after 20, so the temperature is 24°C.

On the second thermometer, the temperature is at the mark halfway between 37 and 38, so it's 37.5°C.

What temperature do you think it is today? If you have a thermometer, check the temperature outside; if you don't, you could use an online resource such as the BBC Weather pages or your mobile phone to find the temperature near you.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 19: Reading thermometers

What temperature is shown on each of these thermometers?

1.

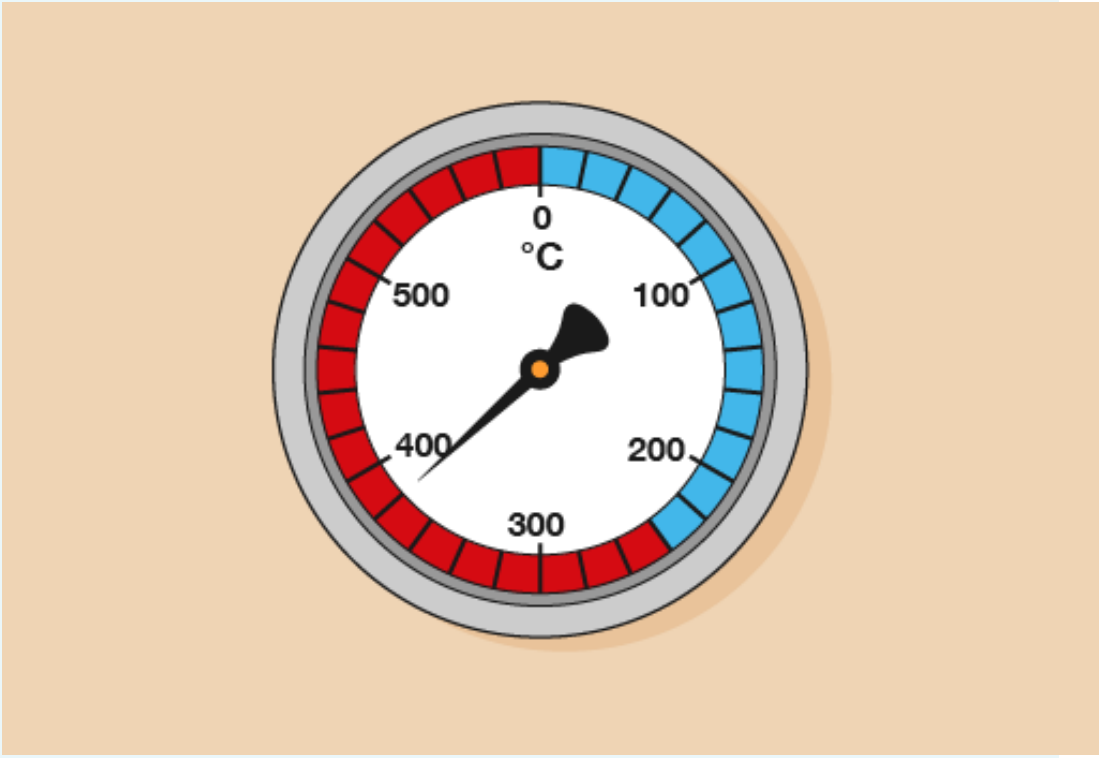


Figure 41 A thermometer

2.

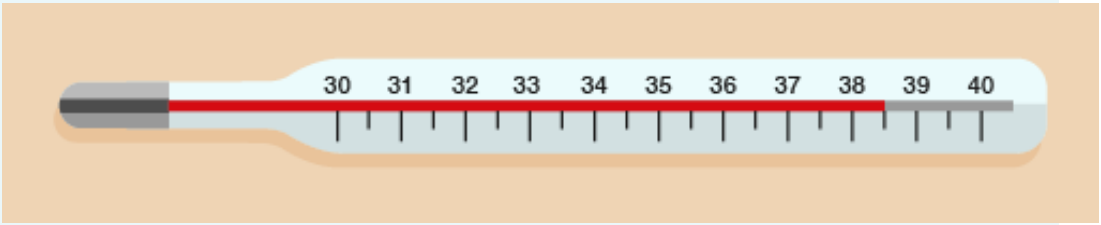


Figure 42 A thermometer

3.

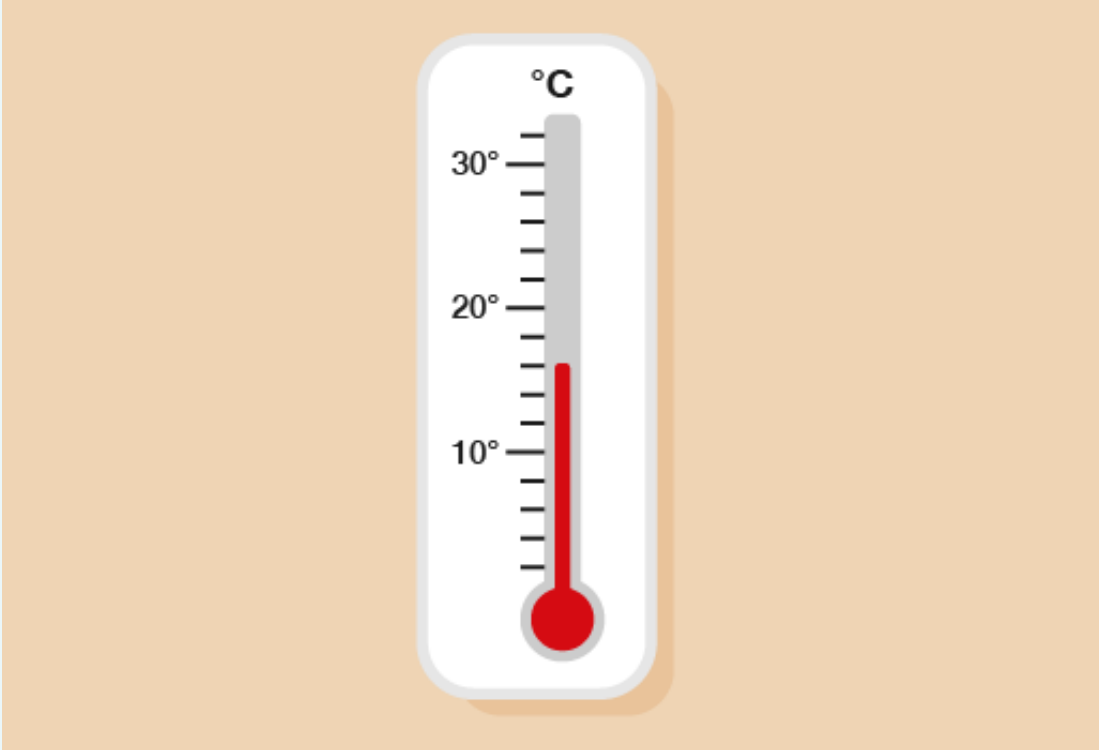


Figure 43 A thermometer

Answer

1. Each mark on the thermometer represents 20°C and the needle is at the mark below 400, so the temperature is 380°C.
2. The reading is on the mark halfway between 38°C and 39°C, so the temperature is 38.5°C.
3. Each mark represents 2°C, so the temperature is 16°C.

5.2 Understanding temperature

Using the right temperature is often a matter of safety. Many things haveto be stored or used in a particular temperature range to be safe. A piece of machinery may not be able to operate properly below a minimum temperature or above a maximum temperature, or a jar of tablets may include advice on its label about what temperature it should be stored at.

Figure 44 Warning labels

Temperatures used to be shown in degrees Fahrenheit. You will still see these measures sometimes. For example:

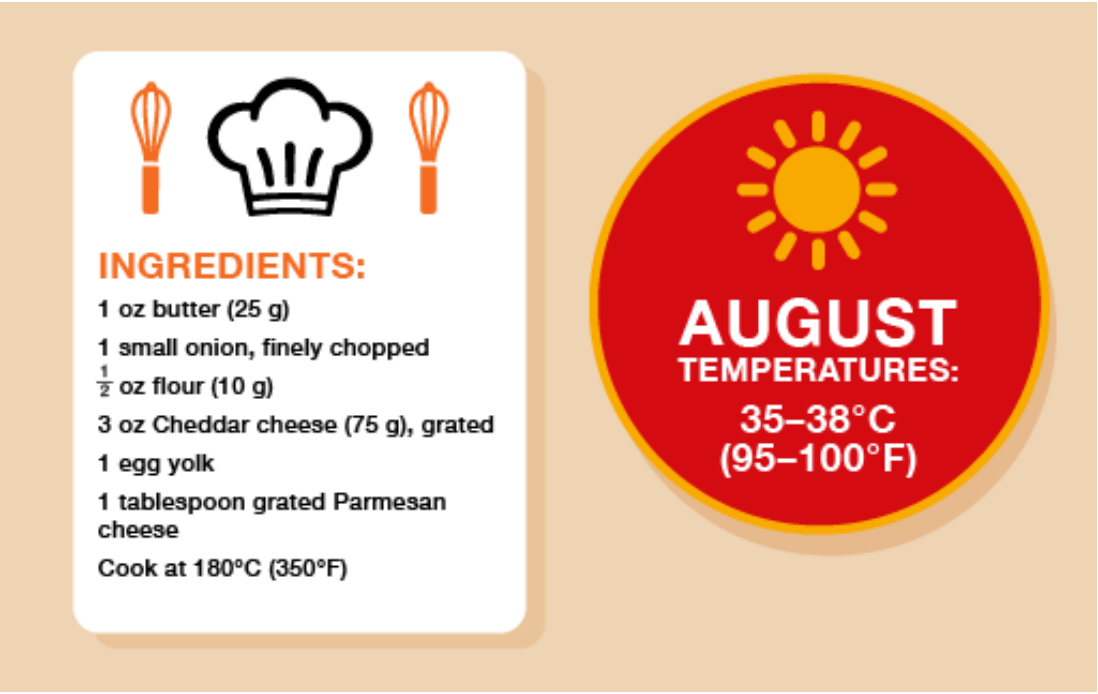


Figure 45 Temperatures in Celsius and Fahrenheit

Note: Fahrenheit is still used in the USA.

Here are some temperatures in Celsius and Fahrenheit:

Celsius	Fahrenheit
–18	0
0	32
10	50
20	68
30	86
40	104
50	122

Take a look at the example below for comparing temperatures.

Example: Safe storage

You have instructions with chemicals sent from the USA that they must be stored at between 50 and 70°F. The thermometer on the storage tank shows the temperature in degrees Celsius.

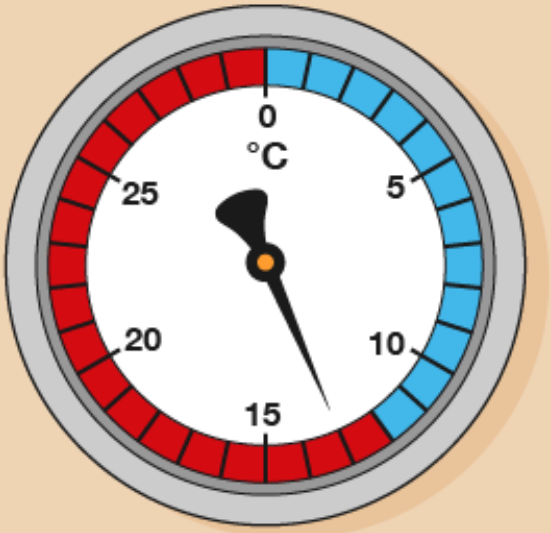


Figure 46 Using a thermometer in safe storage

Are the chemicals stored safely?

Method

Looking at the temperature comparison chart, 13°C falls in the following range:

10°C = 50°F
20°C = 68°F

13°C falls between 10°C and 20°C, meaning that it is also in the range between 50°F and 68°F. The chemicals are stored safely.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 20: Celsius and Fahrenheit

1. A recipe for meringue says you must cook it at 150°C. Your cooker shows temperatures in Fahrenheit. What should you set it to? (Use the conversion chart below to help you.)

Celsius	Fahrenheit
100	212
150	302
200	392
250	482
300	572
350	662

2. The thermometer on an old freezer shows the temperature in degrees Fahrenheit.

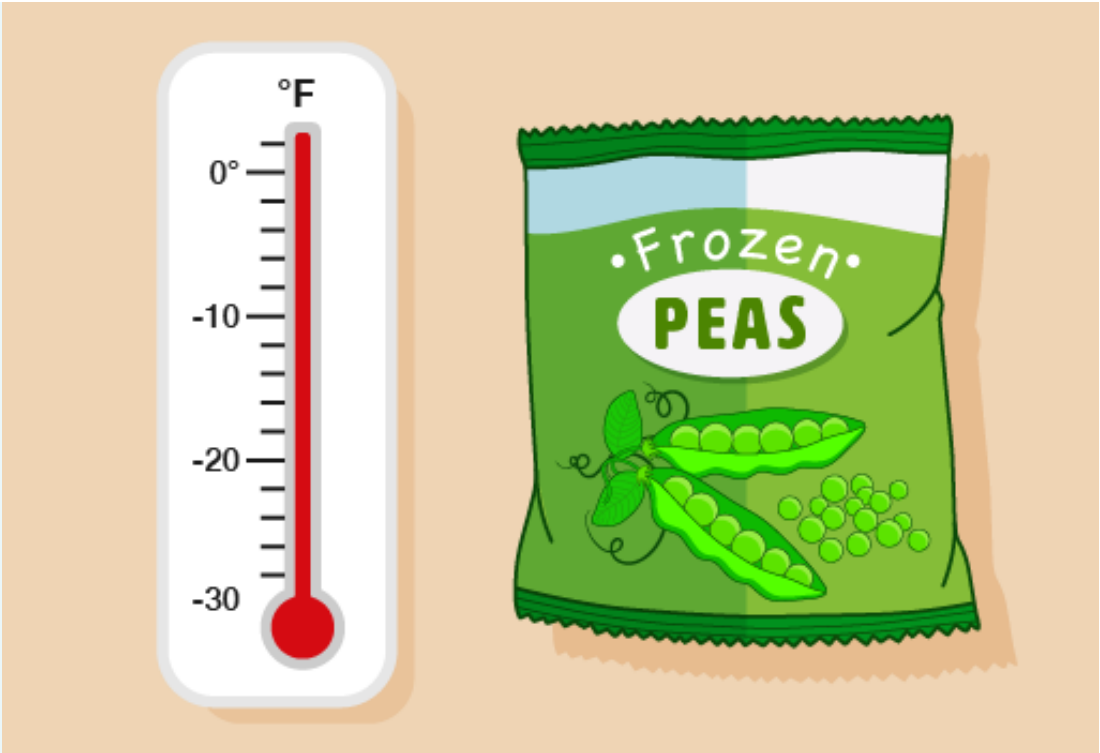


Figure 47 Converting temperatures on old thermometers

A pack of food has a warning that it must be stored between –12°C and –25°C. Is the food stored safely? (Use the conversion chart below to help you.)

Celsius	Fahrenheit
–30	–22
–20	–4
–15	5
–10	14
–5	23
0	32
10	50

3. A machine must be turned off if the temperature rises above 600°F. Using a Celsius thermometer, you find out that the temperature of the machine is:

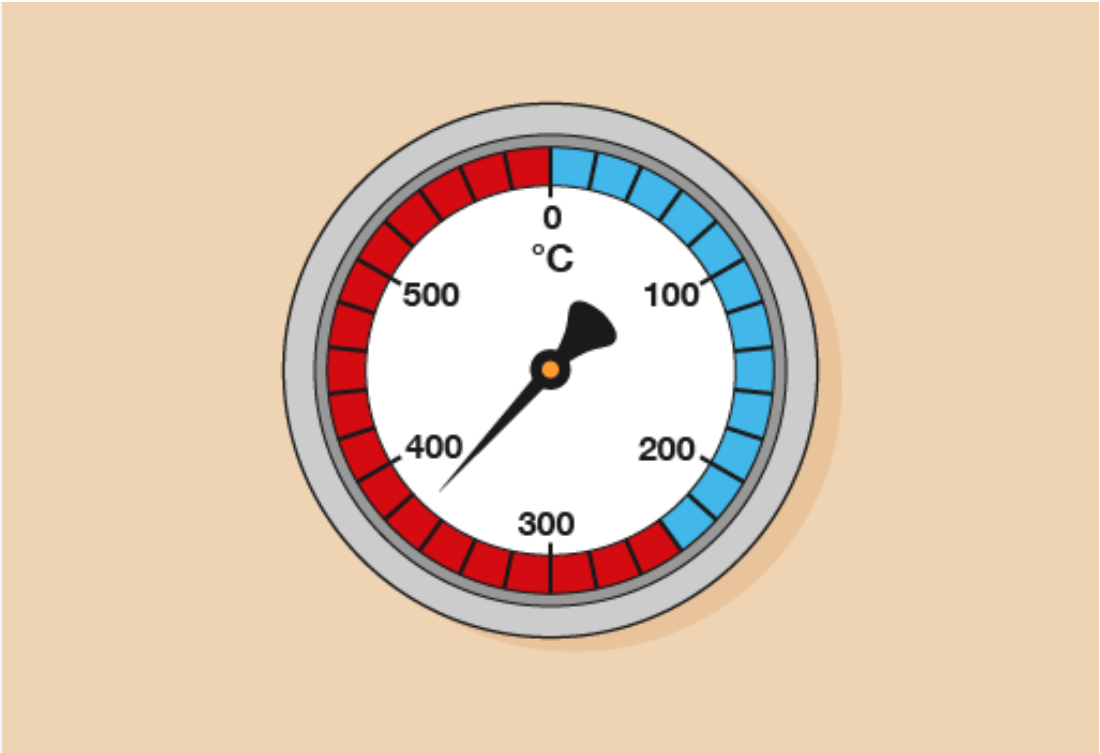


Figure 48 A thermometer

Is it safe to leave it turned on? (Use the conversion chart below to help you.)

Celsius	Fahrenheit
0	32
50	122
100	212
150	302
200	392
250	482
300	572
350	662
400	752

Answer

1. You will see on the conversion chart that 150°C is equivalent to 302°F. The oven would not be marked this accurately, so you should set it to 300°F.
2. The thermometer shows 2°F, which you need to find the Celsius equivalent of. Five degrees Fahrenheit is –15°C; –4°F is –20°C. The temperature is between –15°C and –20°C, so the food is stored safely.

3. You need to find 600°F on the chart. You will see that 300°C is 572°F, and that 350°C is more than 600°F. The temperature on the dial is even higher than this, at 370°C. The machine is therefore not safe and must be switched off.

Summary

In this section you have identified and practised:

- how to solve problems requiring calculation incorporating temperature
- the correct way to read temperature and the difference between the units used.

6 Time

6.1 Dates

Dates are often written in numbers. In the UK we always put the number first, followed by the month and finally the year.

	Month	Abbreviated form
1	January	Jan
2	February	Feb
3	March	Mar
4	April	Apr
5	May	May
6	June	Jun
7	July	Jul
8	August	Aug
9	September	Sep
10	October	Oct
11	November	Nov
12	December	Dec

Examples

12th October 1981 could be written as 12.10.81

17th May 2024 could be written as 17/May/2024

Activity 21: dates on a form

You are completing a form where the date is requested in the format DD/MM/YYYY.
If you were born on the 19th February 1985, we write this as 19/02/1985.

The 5th November 1995 could be written as 05/11/1995.

Using this format:

1. Write the date of birth 12th August 2011
2. Write your date of birth.

Answer

12th August 2011 can be written as 12/08/2011. (The second answer depends on your date of birth.)

Units of time

Find below the most frequently used units of time.

Units of time

60 seconds	=	1 minute
60 minutes	=	1 hour
24 hours	=	1 day
7 days	=	1 week
12 months	=	1 year
52 weeks	=	1 year
365 days	=	1 year
366 days	=	1 leap year (1 extra day)
1 decade	=	10 years
1 century	=	100 years
1 millennium	=	1000 years

From the table we can see that 1 minute has 60 seconds, 1 hour has 60 minutes, 1 day has 24 hours and so on. A year has 365 days except every fourth year (leap year) we have an additional day in February (29th February).

Celebrations and original dates

Some events happen every year, e.g. birthday, anniversary. Other events happen less frequently, e.g. Olympics, FIFA World Cup. Some events celebrate a particular number of years from an original date.

Work out the original date for the following events:

Celebration	Date of celebration	Original date
Decade (10 years)	4 June 2007	
21st birthday	11 November 2000	

Millennium (1000 years)	1st January 2000
Retirement (45 years)	September 2008
Centenary (100 years)	17 September 2004
Diamond Jubilee (60 years)	June 2004

Answer

Answers:

Celebration	Date of celebration	Original date
Decade (10 years)	4 June 2007	4 June 1997
21st birthday	11 November 2000	11 November 1979
Millennium (1000 years)	1st January 2000	1st January 1000
Retirement (45 years)	September 2008	September 1963
Centenary (100 years)	17 September 2004	17 September 1904
Diamond Jubilee (60 years)	June 2004	June 1944

6.2 Clocks

What's the difference between the 12-hour clock and the 24-hour clock?

12-hour clock	24-hour clock
The hours go from 12 to 12, twice a day You must use 'a.m.' or 'p.m.': 'a.m.' means 'before noon' and 'p.m.' means 'after noon'	The hours go from 0 to 23 Time is always shown in four digits You do not use 'a.m.' or 'p.m.' Commonly used in timetables, mobile phones and computers

Example: Converting times before noon

It is easy to change from the 12-hour clock to the 24-hour clock for times before noon (or times ending 'a.m.'). So for example, '4:25 a.m.' would be written as '04:25'. '11:35 a.m.' would be '11:35'.

(Note that many timetables don't show the colon in the 24-hour clock, so these times would be shown as '0425' or '1135'.)

How would you write a quarter to eight in the morning as a 24-hour clock time?

Method

Fifteen minutes before eight o'clock is the same as 45 minutes past 7, so it is written as 07:45.

To change from the 12-hour clock to 24-hour clock for times after noon (ending 'p.m.'), youusually need to add 12 hours.

Example: Converting times after noon

1. How would you express 8:15 p.m. using the 24-hour clock?
2. How would you write quarter to eight in the evening as a 24-hour clock time?

Method

1. You need to add 12 hours:

$$\begin{array}{rr} & 8:15 \\ + & 12:00 \\ \hline & 20:15 \\ \hline \end{array}$$

So 8:15 p.m. is 20:15 in a 24-hour clock.

2. You add 12 hours:

$$\begin{array}{rr} & 7:45 \\ + & 12:00 \\ \hline & 19:45 \\ \hline \end{array}$$

So 7:45 p.m. is 19:45 in a 24-hour clock.

Hint: Take care with times with the hour of 12. So quarter past midnight, or 12:15 a.m. is 00:15 in a 24-hour clock. Likewise quarter past midday, or 12:15 p.m., is 12:15 in a 24-hour clock.

Now try the following activity.

Activity 22: The 24-hour clock

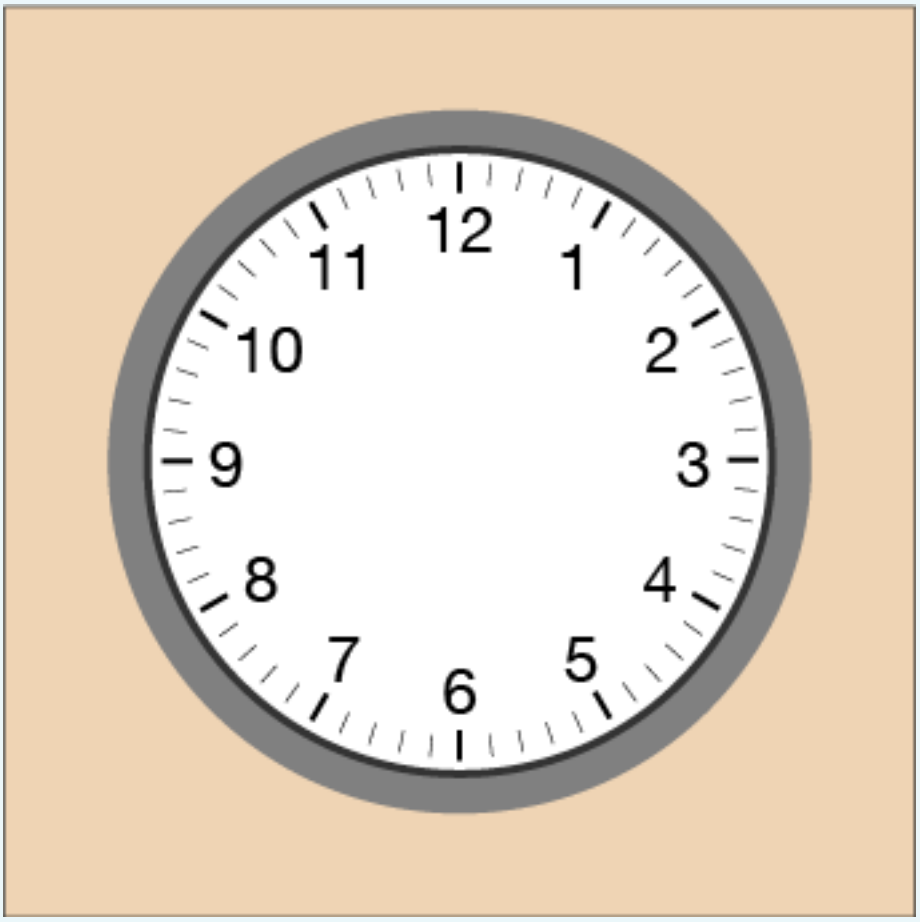


Figure 49 A clock face

Express the following times in the 24-hour clock. Remember, for *some* of the times you will need to use the method of adding on 12 hours to convert the time intothe 24-hour format. You could use Figure 49 to help you count on 12 hours.

1. 8:15 a.m.
2. 2:50 p.m.
3. 5:40 a.m.
4. 9:22 p.m.
5. Ten to ten in the morning
6. Five past six in the evening

Answer

1. 08:15
2. 14:50
3. 05:40
4. 21:22
5. 09:50
6. 18:05

6.3 Calculate time difference

You may need to work out differences in time, e.g. to work out the length of a TV programme or journey time.

There are different ways to work out the difference in time. One of the easiest ways is to use the adding on method.

Example: Time difference by adding on

How long is it from 08:45 to 10:30?

Method

The start time is 08:45.

The number of minutes between 08:45 and the start of the next hour, 09:00, is 15 minutes.

The number of hours between 09:00 and 10:00 is one hour.

The number of minutes between 10:00 and 10:30 is 30 minutes.

So the time between 08:45 to 10:30 is:

15 minutes + 30 minutes + 1 hour = 1 hour 45 minutes

Now try the following activity.

Activity 23: Time difference

What is the length of time between the following times?

1. 03:55 to 06:35
2. 09:45 to 12:15
3. 08:26 to 10:14
4. 7:55 a.m. to 1:10 p.m.
5. Midday to 15:50
6. 3:15 am to midnight

Answer

1. The start time is 03:55.
   The number of minutes between 03:55 and the start of the next hour, 04:00, is 5 minutes.
   The number of hours between 04:00 and 06:00 is two hours.
   The number of minutes between 06:00 and 06:35 is 35 minutes.
   So the time between 03:55 to 06:35 is:
   5 minutes + 35 minutes + 2 hours = 2 hours 40 minutes
2. The start time is 09:45.

The number of minutes between 09:45 and the start of the next hour, 10:00, is 15 minutes.

The number of hours between 10:00 and 12:00 is two hours.

The number of minutes between 12:00 and 12:15 is 15 minutes.

So the time between 09:45 to 12:15 is:

15 minutes + 15 minutes + 2 hours = 2 hours 30 minutes

Following the same method, you should have these answers for the other questions:

3. 1 hour 48 minutes
4. 5 hours 15 minutes
5. 3 hours 50 minutes
6. 20 hours 45 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 practice converting units of time.

6.4 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.

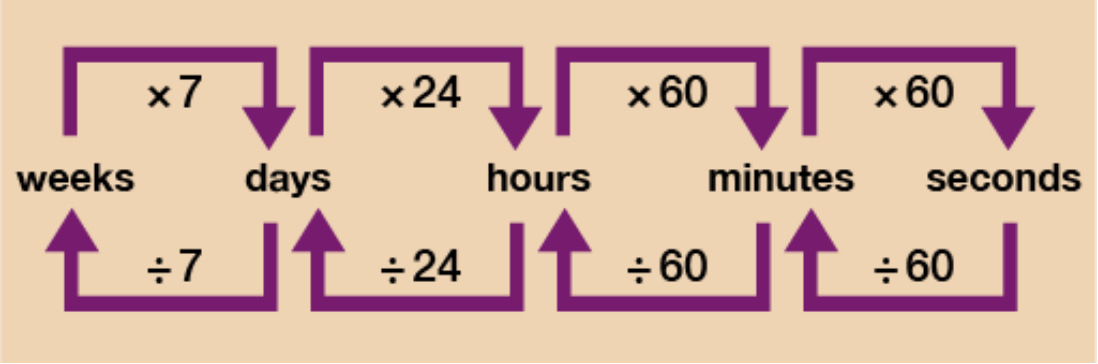


Figure 50 A conversion chart for time

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 $5 \times 60 = 300$ 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 24: Converting times

Convert the following times:

1. 6 hours and 35 minutes = ___ minutes.
2. 85 minutes = ____ hours and ____ minutes.
3. 153 seconds = ____ minutes and ___ seconds.
4. 46 days = ___ weeks and ____days.
5. 3 minutes and 40 seconds = ____ seconds.

Answer

1. 6 hours = $6 \times 60 = 360$ minutes
   360 minutes + 35 minutes = 395 minutes
2. 85 minutes $\div$ 60 = 1.417 (rounded to three d.p)
   1 hour = 60 minutes.
   85 minutes − 60 minutes = 25 minutes remaining
   So 85 minutes = 1 hour and 25 minutes
3. 153 seconds $\div$ 60 = 2.55
   2 minutes = $2 \times 60 = 120$ seconds
   153 seconds − 120 seconds = 33 seconds remaining
   So 153 seconds = 2 minutes and 33 seconds
4. 46 days $\div$ 7 = 6.571 (rounded to three d.p)
   6 weeks = $6 \times 7 = 42$ days
   46 days − 42 days = 4 days remaining
   So 46 days = 6 weeks and 4 days
5. 3 minutes = $3 \times 60 = 180$ seconds
   180 seconds + 40 seconds = 220 seconds

7 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.

8 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:

- solve problems requiring calculation with common measures, including time, length, weight, capacity and temperature
- convert units of measure in the same system
- calculate distance between towns and cities using a distance chart.

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.

Session 3: Shape and space

1 Shapes

1.1 Polygons

A polygon is simply a general term for a shape with straight sides.

Activity 1: Identifying polygons

Which of the following shapes are polygons?

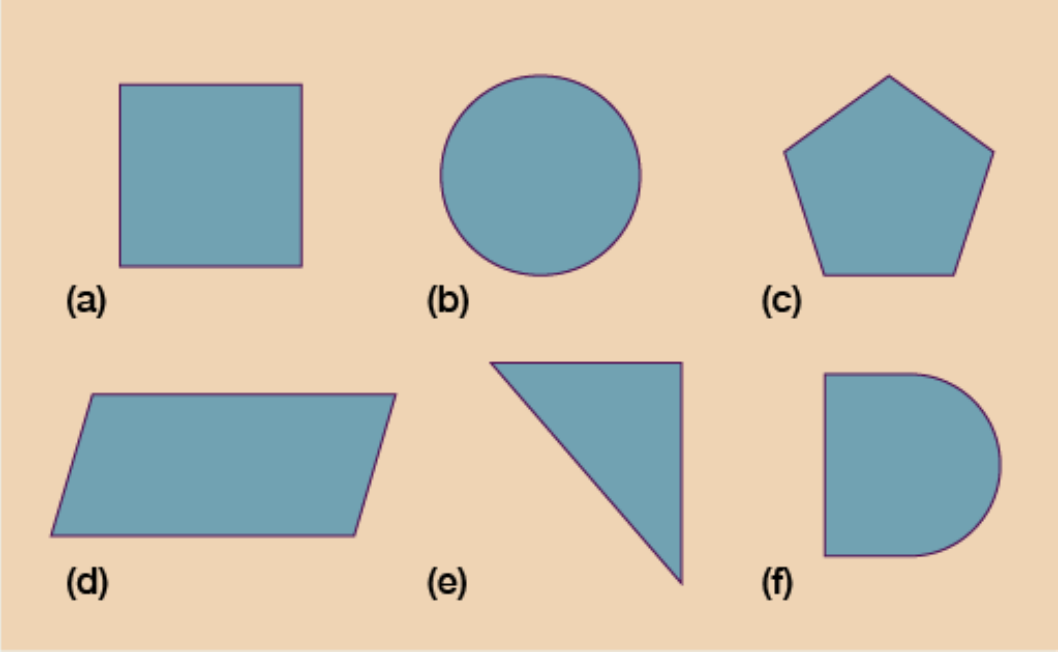


Figure 1 Six shapes

Answer

Shapes (a), (c), (d) and (e) are polygons. Shapes (b) and (f) are not polygons because they have curved sides.

A regular polygon is a shape with sides that are the same length and angles that are all the same size.

A polygon with six sides is a hexagon. The shapes in Figure 2 are both hexagons, but only one is a regular hexagon.

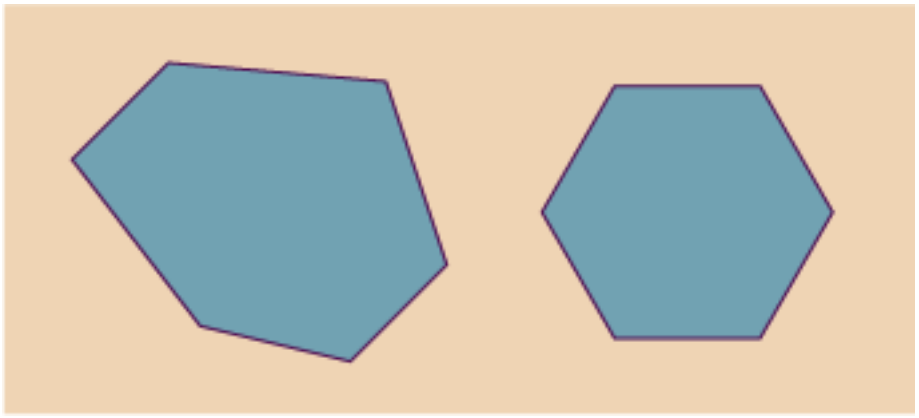


Figure 2 Two hexagons

1.2 Angles

An angle is formed where two straight lines (or sides) meet. Angles are measured in degrees, which is shown by using the symbol ° after the number of degrees. So for example, 45° means an angle of 45 degrees.

Note: Do not confuse these with degrees Celsius, centigrade or Fahrenheit, which are used to measure temperature.

There are 360° in a circle. There are 180° in a half-turn – that is, from north to south on a compass, or from 9 to 3 on a clock.

An angle of 90° is a quarter-turn – from north to east on a compass, or from 12 to 3 on a clock. These angles are also known as right angles. Right angles are shown like this:

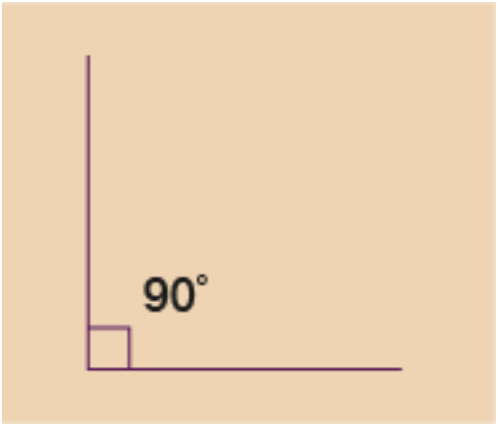


Figure 3 A right angle

Right angles are very common in everyday life. Look around you and see how many you can spot.

Here are a few examples of where you might have noticed a right angle:

- the corners of your screen (a corner is where two lines meet)
- corners of windows

- the corners of a book page
- where the walls meet the floor
- where the table legs meet the top.

Angles of less than 90° are called acute angles. Angles of more than 90° are called obtuse angles.

Activity 2: Angles

Which angles in Figure 4 are right angles, acute angles or obtuse angles?

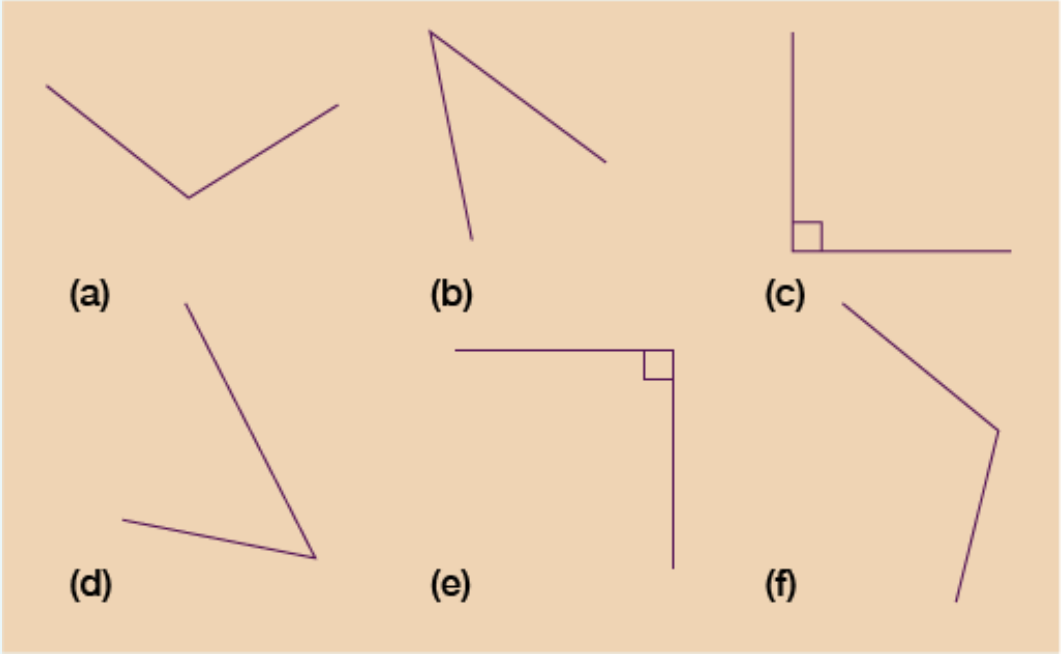


Figure 4 Angles

Answer

Angles (a) and (f) are obtuse angles (greater than 90°).
Angles (b) and (d) are acute angles (less than 90°).
Angles (c) and (e) are right angles (exactly 90°).

1.3 2D and 3D shapes

‘2D’, or ‘two-dimensional’, simply means that the shape is flat. We can draw 2D shapes on paper. Common examples are shown in Figure 5.

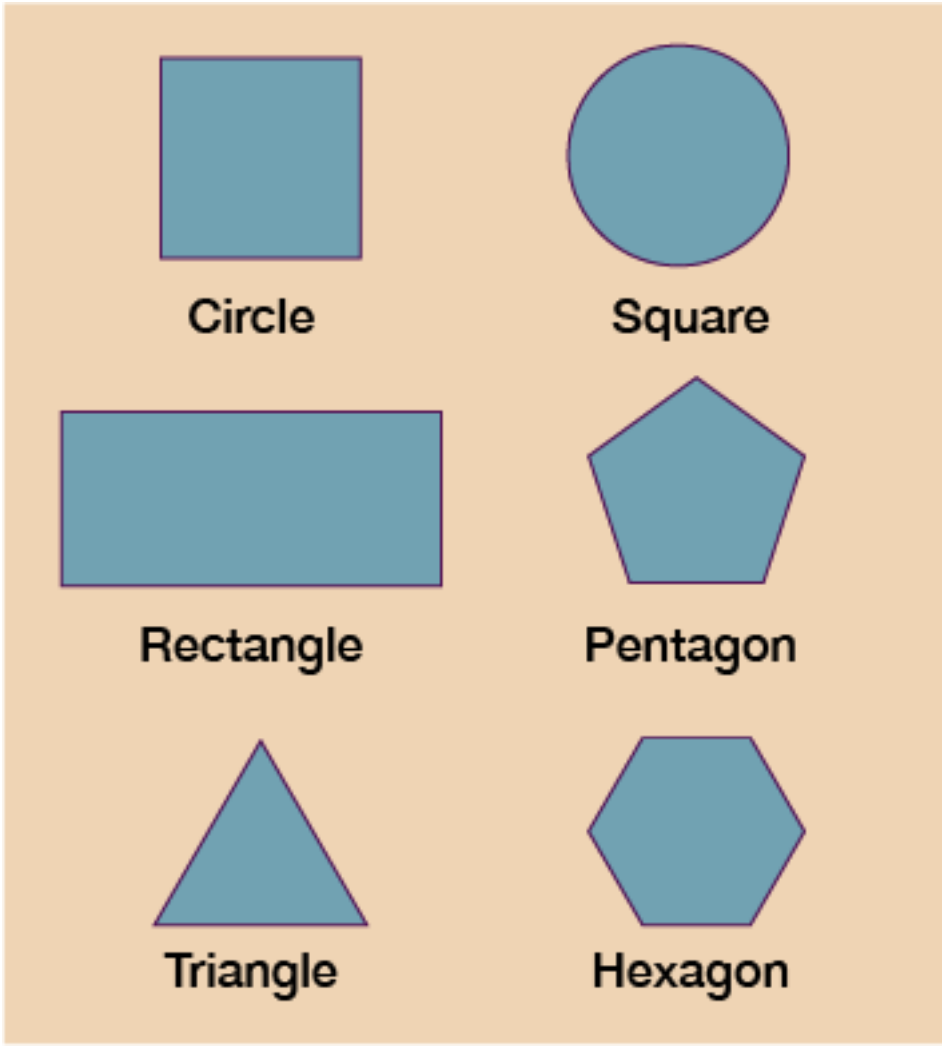


Figure 5 2D shapes

A ‘3D’ (‘three-dimensional’) shape is a solid shape. It has three dimensions, that is, length, width and depth. An easy way of thinking about the difference between a 2D and a 3D shape is to think ‘If I shone a torch on the shape, would it have a shadow?’ 3D shapes cast a shadow but 2D shapes don’t.

Obviously the screen that you’re reading this on is 2D, so 3D shapes are represented using shading.

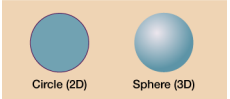


Figure 6 A 2D and 3D shape

Activity 3: 2D or 3D?

Say if the following shapes are 2D or 3D:

Which shapes in Figure 7 are 2D and which are 3D?

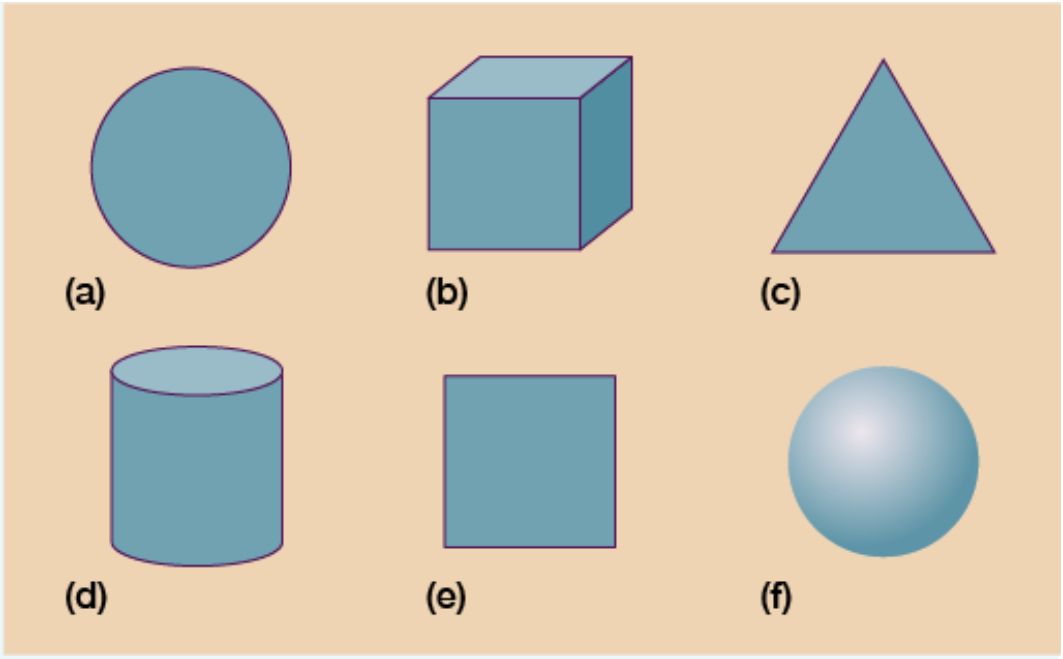


Figure 7 2D and 3D shapes

Answer

Shapes (a), (c) and (e) are 2D.
Shapes (b), (d) and (f) are 3D.

1.4 Common 3D shapes

You will be familiar with some common 3D shapes.

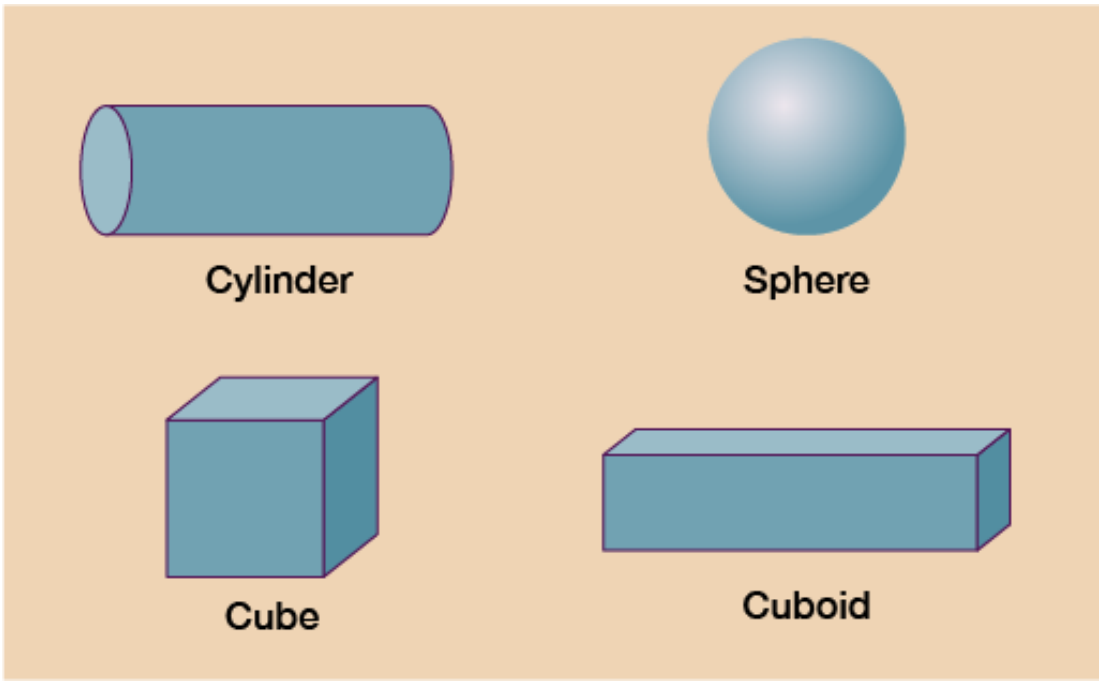


Figure 8 3D shapes

Hint: Make sure you understand the difference between a cube (3D square) and a cuboid (3D rectangle).

Some other 3D shapes that you may come across are shown in Figure 9.

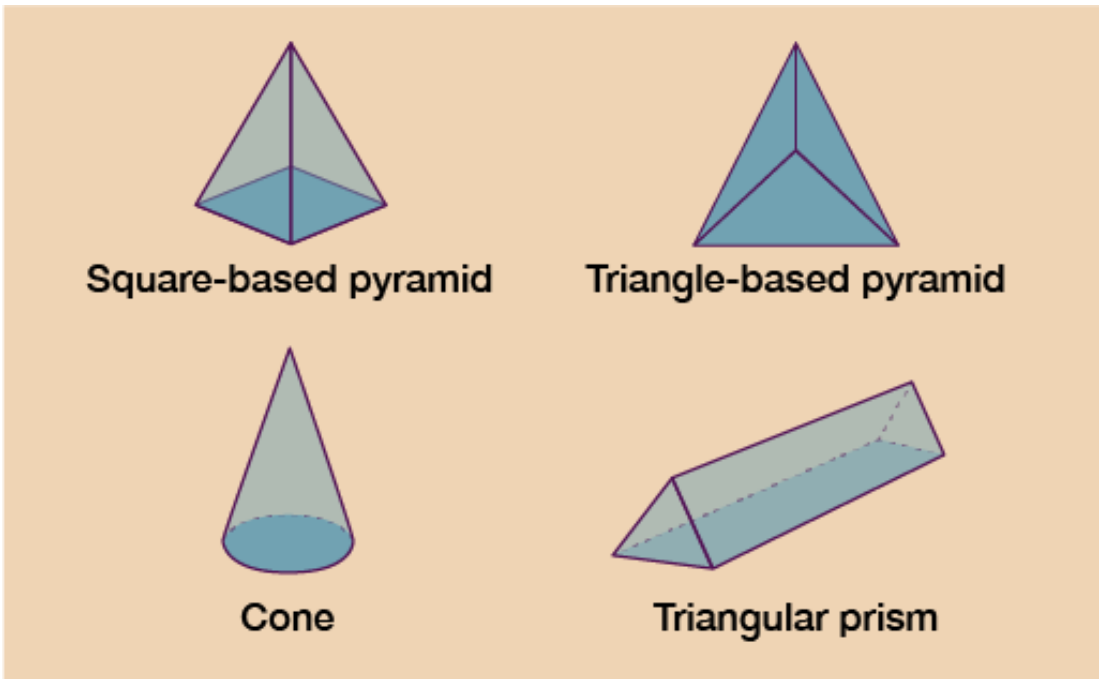


Figure 9 3D shapes

Now try the following activity.

Activity 4: Properties of 3D shapes

1. The sides of 3D shapes are known as faces. Complete the following table:

Shape	Number of faces
Cube	*Provide your answer...*
Square-based pyramid	*Provide your answer...*
Sphere	*Provide your answer...*
Cylinder	*Provide your answer...*
Cuboid	*Provide your answer...*
Cone	*Provide your answer...*
Triangular-based pyramid	*Provide your answer...*
Triangular prism	*Provide your answer...*

Answer

Shape	Number of faces
Cube	6
Square-based pyramid	5
Sphere	1
Cylinder	3
Cuboid	6
Cone	2

Triangular-based pyramid	4
Triangular prism	5

As well as faces, 3D shapes also have edges and vertices (corners):

View at: youtube:6x1-_vA-0-s

2. Complete the following table:

Shape	Number of edges	Number of vertices
Cube	*Provide your answer...*	*Provide your answer...*
Square-based pyramid	*Provide your answer...*	*Provide your answer...*
Sphere	*Provide your answer...*	*Provide your answer...*
Cylinder	*Provide your answer...*	*Provide your answer...*
Cuboid	*Provide your answer...*	*Provide your answer...*
Cone	*Provide your answer...*	*Provide your answer...*
Triangular-based pyramid	*Provide your answer...*	*Provide your answer...*
Triangular prism	*Provide your answer...*	*Provide your answer...*

Answer

Shape	Number of edges	Number of vertices
Cube	12	8
Square-based pyramid	8	5

Sphere	0	0
Cylinder	2	0
Cuboid	12	8
Cone	1	1
Triangular-based pyramid	6	4
Triangular prism	9	6

A sphere has just one curved face, so it has no edges or vertices.

2 Symmetry

A 2D symmetrical shape can be folded in half so that both sides are the same. The fold is called a line (or lines) of symmetry.

The shapes in Figure 10 have one line of symmetry.

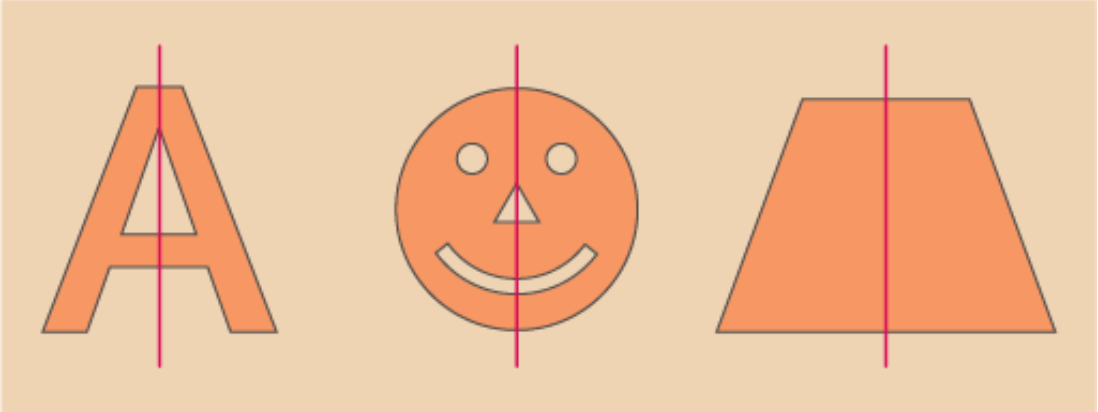


Figure 10 One line of symmetry

Some shapes, such as the middle one above, will only have one line of symmetry because of the details included, like the eyes, nose and mouth. However, a circle with no added details has an infinite number of lines of symmetry!

The shapes in Figure 11 have multiple lines of symmetry.

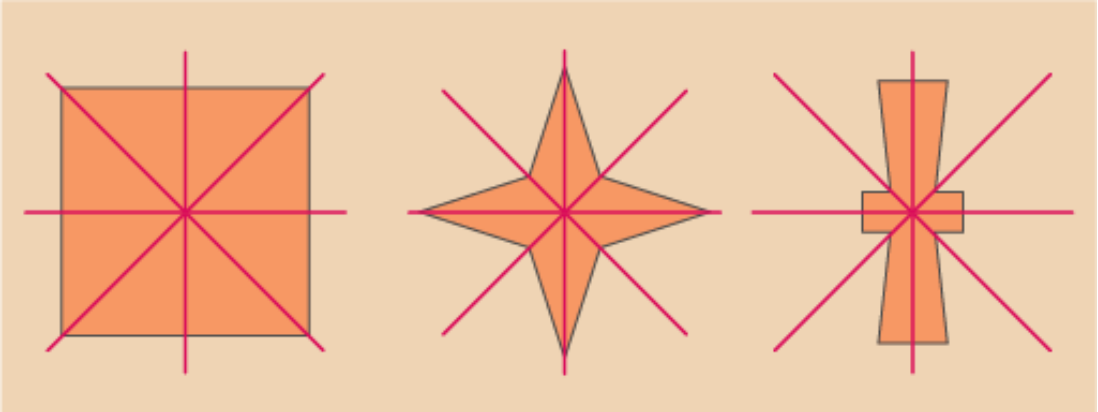


Figure 11 Multiple lines of symmetry

Now try the following activity.

Activity 5: Lines of symmetry

How many lines of symmetry in Figure 12 does each of these letters have?

Figure 12 How many lines of symmetry?

Answer

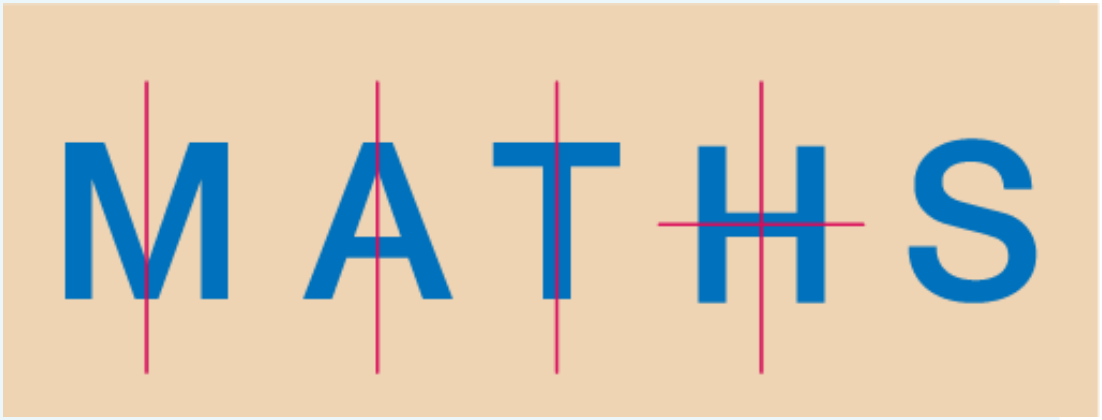


Figure 13 Lines of symmetry

'M', 'A' and 'T' have one line of symmetry.

'H' has two lines of symmetry.

'S' has no lines of symmetry.

Activity 6: How many lines of symmetry?

Sometimes a line of symmetry is called a mirror line, because if you placed a mirror along the line the shape would look the same.

Try writing your name in capital letters and seeing how many lines of symmetry each letter has. You could use a mirror to check your answers.

3 Around the edge

When might you need to work out how far it is around a flat shape?

You will need to know how far it is around the edge of a shape when you want to put a border around something, such as a wallpaper border around a room, or a brick wall around a patio. You might have thought of different examples.

The distance around any shape is called the perimeter. You can work out the perimeter by adding up all of the sides. The sides are measured in units of length or distance, such as centimetres, metres or kilometres. When you calculate the perimeter of a shape, you need to make sure that all of the measurements are in the same units, converting if necessary.

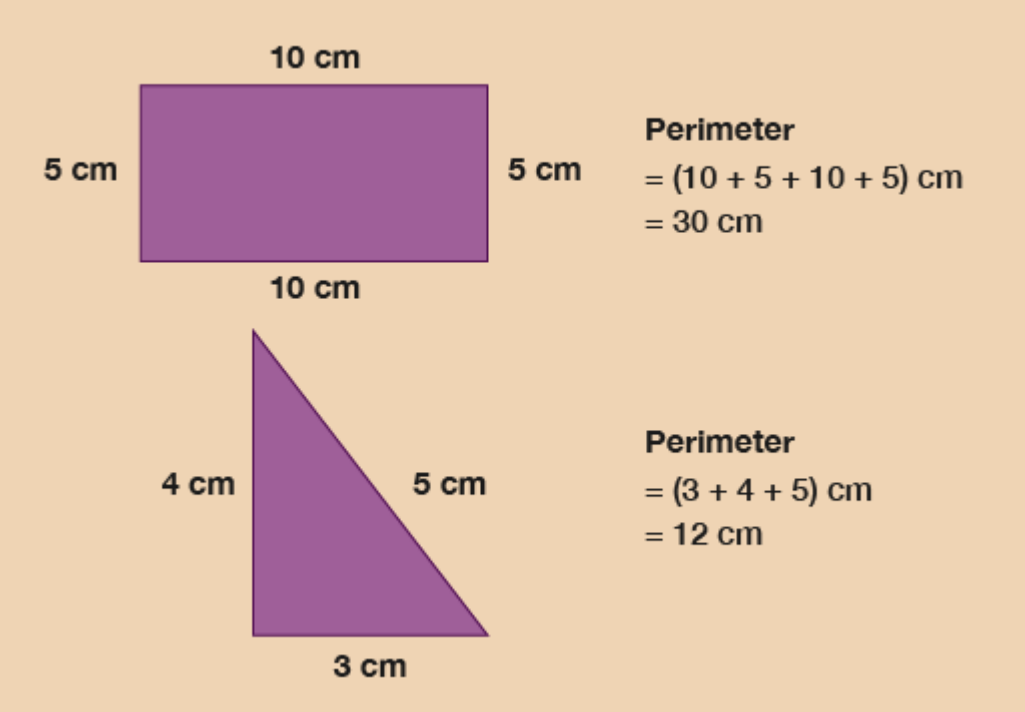


Figure 14 Looking at perimeters

Example: A length of ribbon

Have a look at Figure 15 to work out how much decorative ribbon you need to go around each shape.

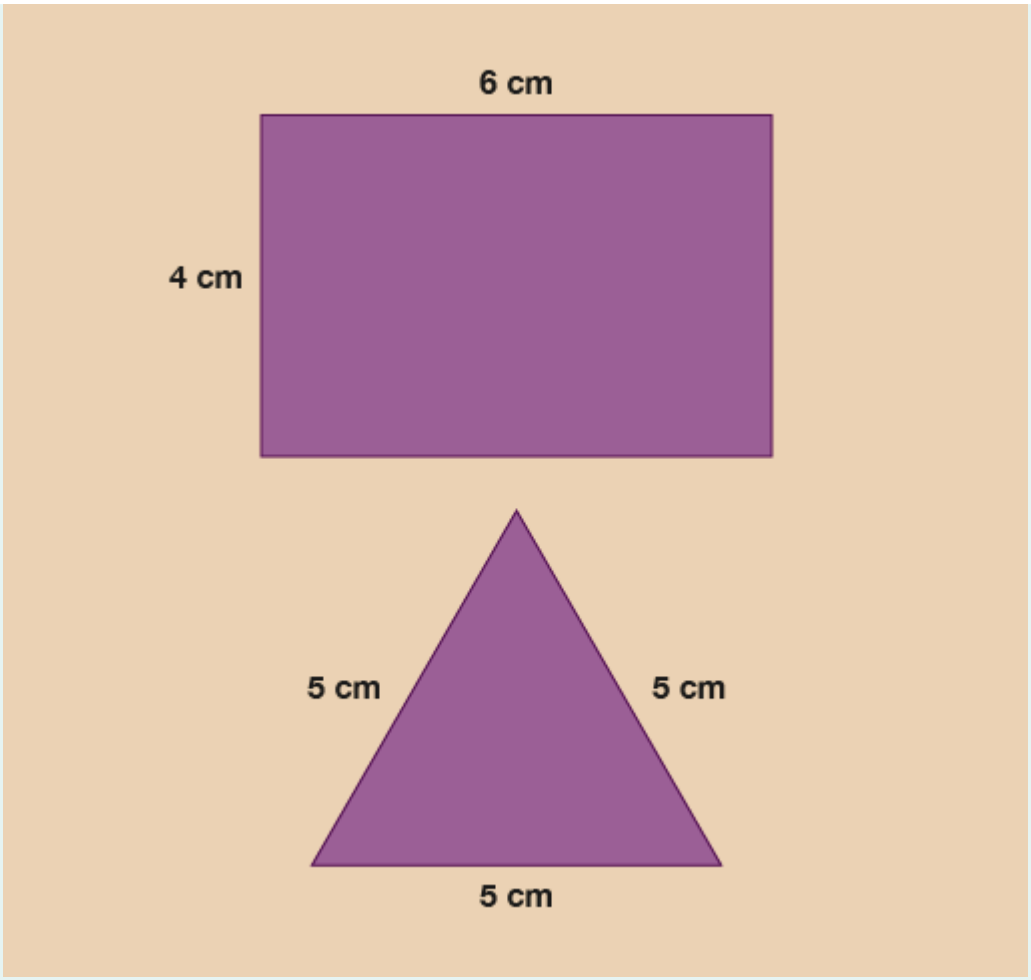


Figure 15 Calculating the length of ribbon

Method

You need to measure all the sides and add them together.

Hint: Opposite sides of a rectangle are the same length.

The sides of the rectangular box are:

6 + 6 + 4 + 4 = 20 cm

You will need 20 cm of ribbon.

The sides of the triangular box are:

5 + 5 + 5 = 15 cm

You will need 15 cm of ribbon.

Example: Lawn edging

So far when you have been working out the perimeter of a rectangle you have added up all four sides. However, there is a quicker way of calculating the perimeter. You may have recognised that all rectangles have two equal short sides and two equal long sides. Therefore you can then work out the perimeter of a rectangle by using each number twice.

(2 × long side) + (2 × short side) = perimeter

The long side is the length. The short side is the width.

(A square is a type of rectangle where all four sides are the same length. So to find out the perimeter of a square, you need to multiply the length of one side by 4.)

How many metres of lawn edging do you need to go around this lawn?

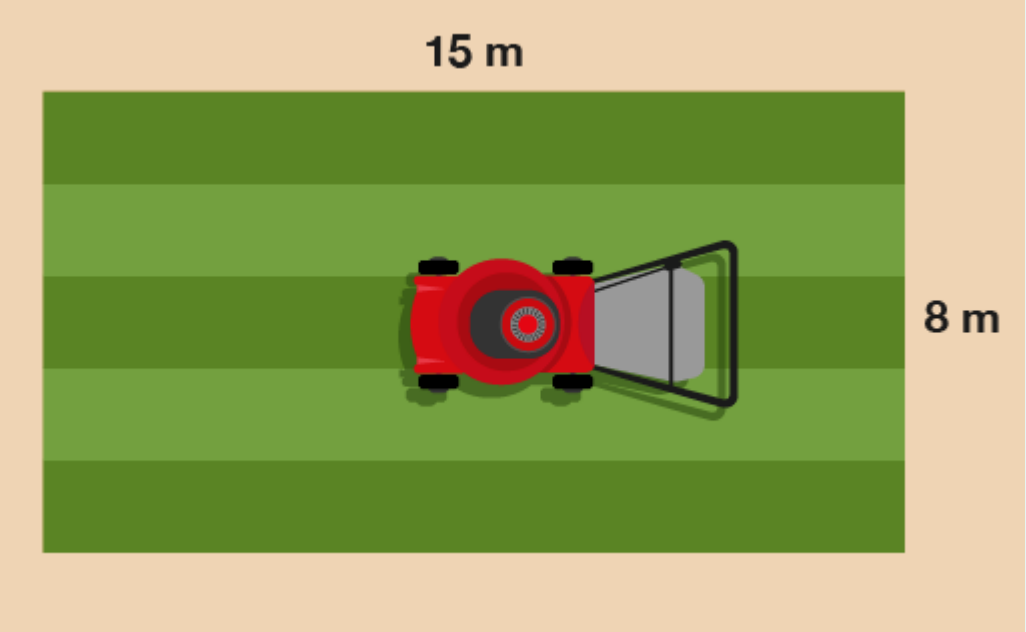


Figure 16 A lawn

Method

You need to work out twice the width, plus twice the length:

(2 × 15) + (2 × 8)

Once you've worked these out, it makes the answer to the question easier to get:

(2 × 15) + (2 × 8) = 30 + 16 = 46 m

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 7: Finding the perimeter

1. You need to hang bunting around the tennis courts for the local championships. How much bunting do you need?

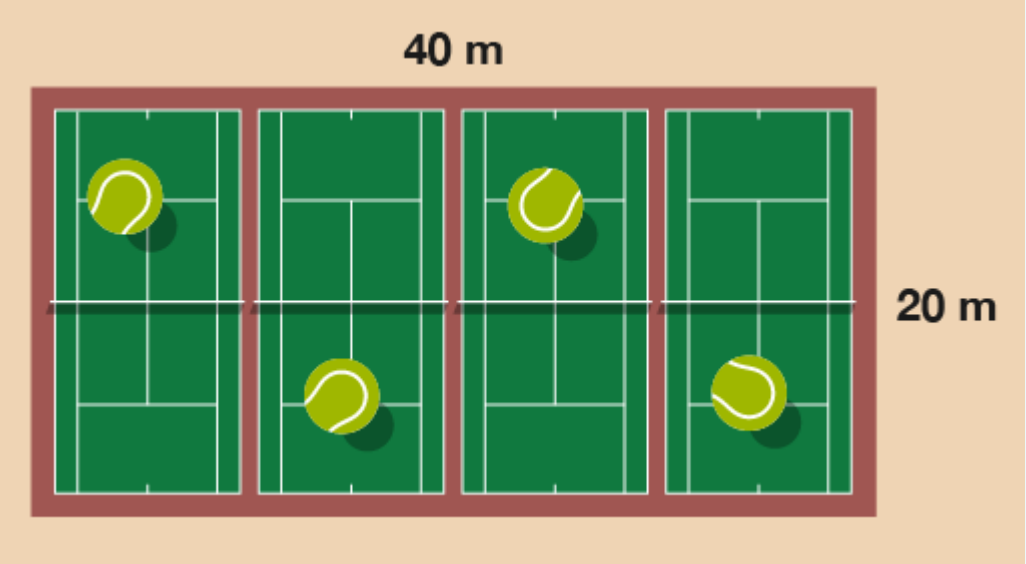


Figure 17 Four tennis courts

2. Jackie wants to put a fence around her vegetable garden. Her garden is rectangular in shape and is 5 metres long by 4 metres wide. What length of fence is needed?

Answer

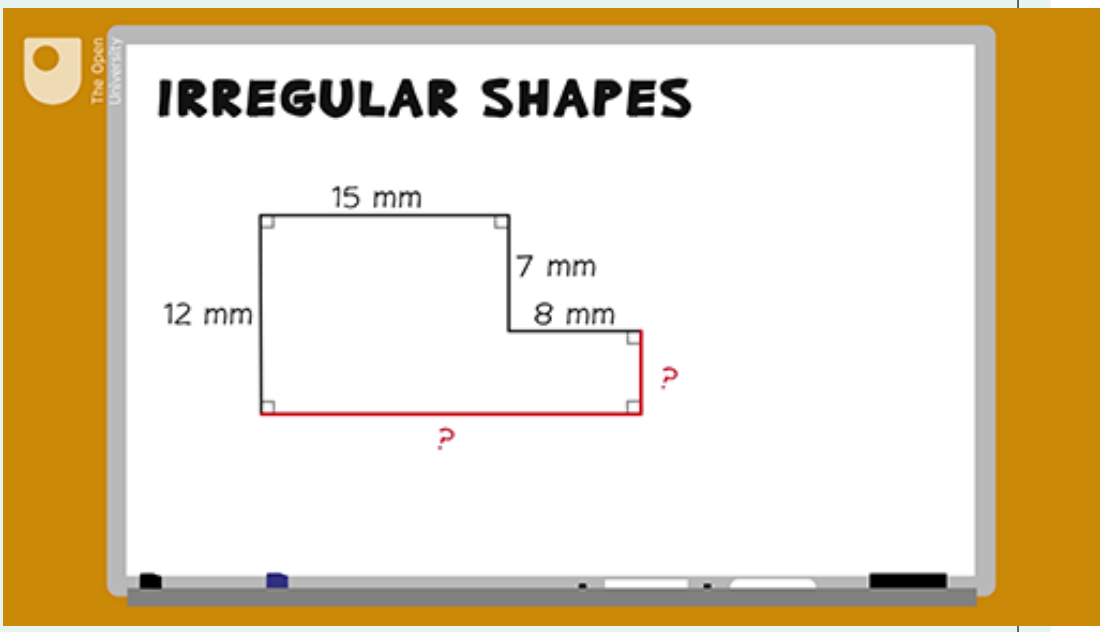
1. The sides of the tennis courts are 20 m and 40 m.
   $(2 \times 20) + (2 \times 40) = 40 + 80 = 120$
   So 120 m of bunting will be needed.
2. The sides of the garden are 5 m and 4 m.
   $(2 \times 5) + (2 \times 4) = 10 + 8 = 18$
   So 18 m of fencing will be needed.

3.1 Measuring the perimeter of irregular shapes

Example: How to measure the perimeter of an irregular shape

How would you measure the perimeter of an irregular shape – an L-shaped room, for instance – if you didn't have all of the measurements that you would need? Watch the following video to find out.

Video content is not available in this format.



Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 8: Finding the perimeter

Note that you can assume that all of the corners in the images in this activity are right angles.

1. A gardener decides to lay a new path next to his lily pond. The drawing shows the dimensions of the path.

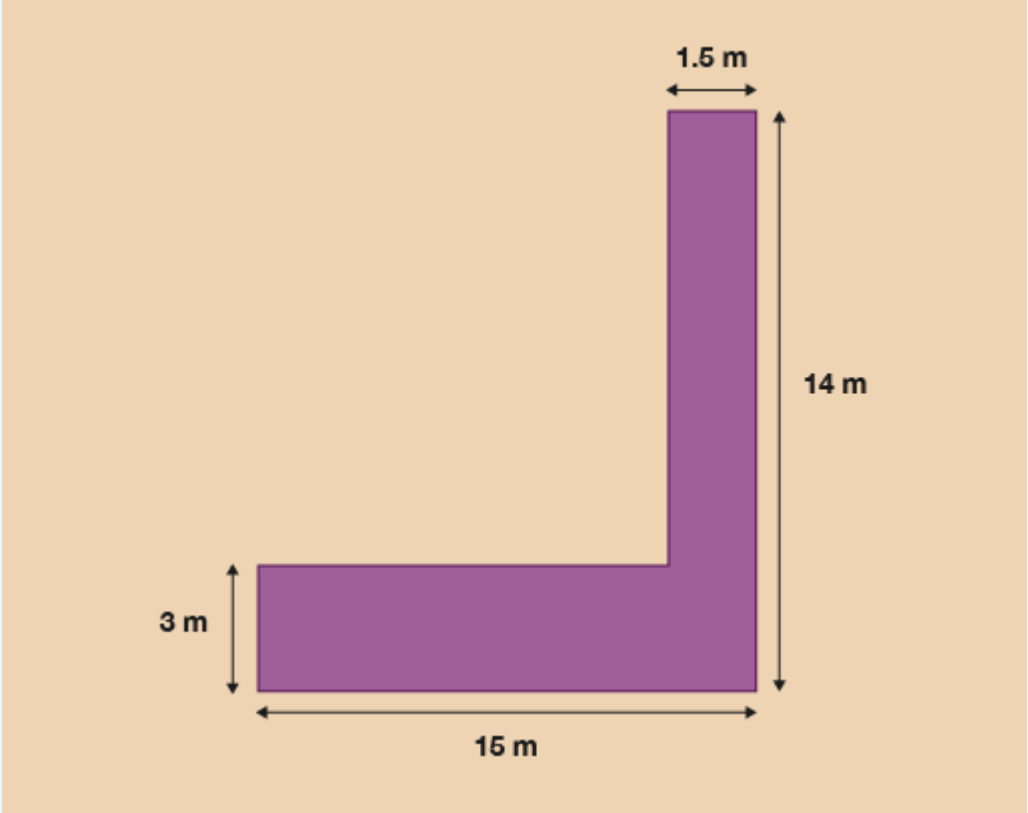


Figure 18 A pathway

The gardener decides to paint a white line around the perimeter of the path. What is the perimeter of the path?

2. A tourist information centre has a new extension.

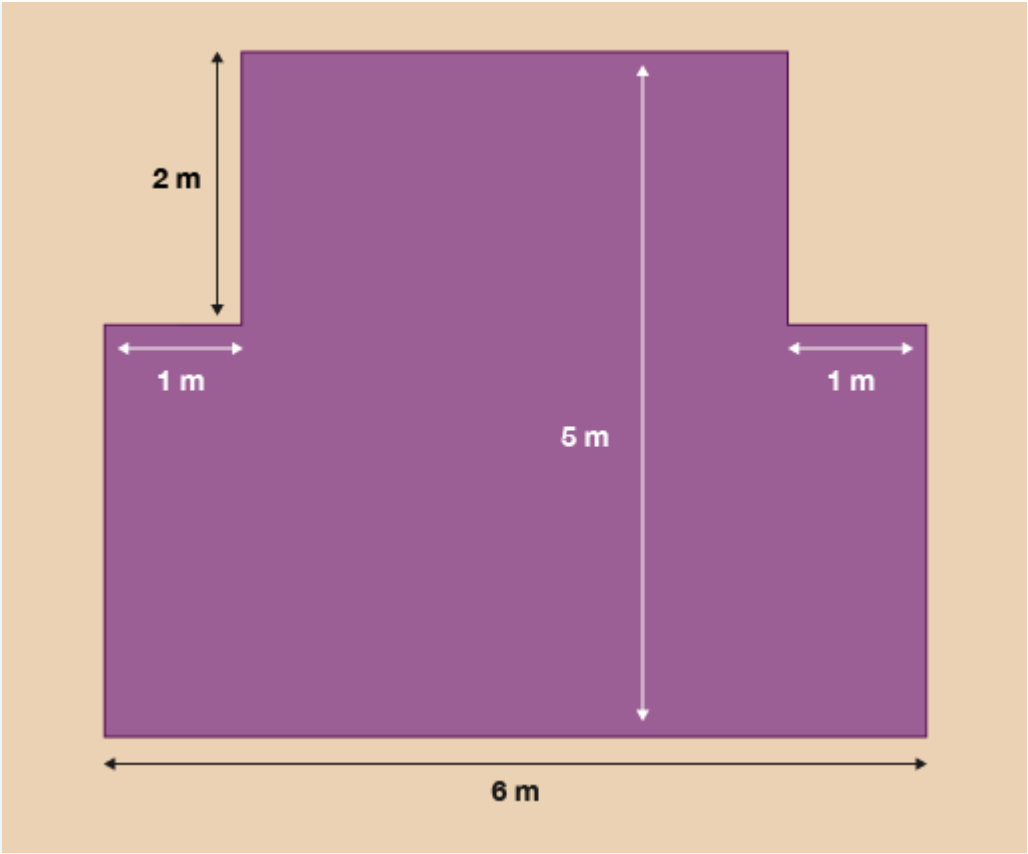


Figure 19 A new extension

The tourist board wants to attach a gold strip around the border of the floor of the building. What is the perimeter of the new extension?

Answer

1. To calculate the missing sides you should have carried out the following calculations:

   14 – 3 = 11

   15 – 1.5 = 13.5

   Now that you have found the missing sides, you can add them all together:

   15 + 14 + 1.5 + 3 + 13.5 + 11= 58 m

2. To calculate the missing sides you need to carry out the following calculations to calculate the perimeter:

   5 – 2 = 3

   6 – 2 = 4

   Now that you have found the missing sides, you can add them all up together to calculate the perimeter:

   6 + 3 + 3 + 1 + 1 + 2 + 2 + 4 = 22 m

Summary

In this section you have learned how to work out the perimeter of both simple and irregular shapes.

4 Area

Area is the amount of space a flat shape takes up. You need to be able to calculate area if you ever need to order a carpet for your house, buy tiles for a kitchen or bathroom, or calculate how much paint to buy when redecorating.

This patio has paving slabs that are 1 metre square (each side is 1 metre). How many paving slabs are there on the patio?

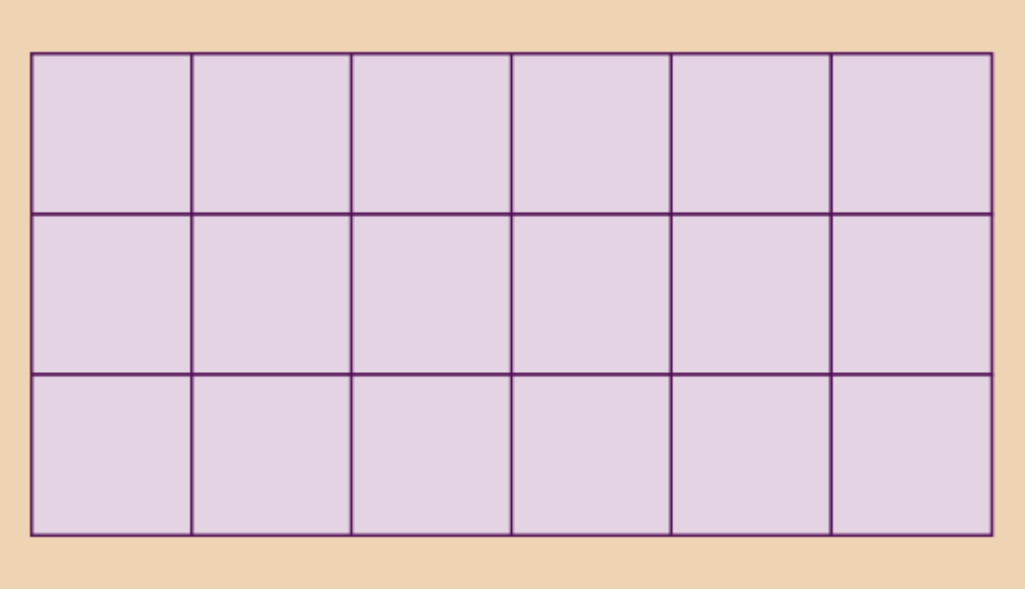


Figure 20 Paving slabs

Area is measured in ‘square’ units. This means that the area is shown as the number of squares that would cover the surface. So if a patio covered with 18 squares that are 1 metre by 1 metre, the area is 18 square metres.

(If you count them, you will find there are 18 squares.)

Smaller areas would be measured in square centimetres. Larger areas can be measured in square kilometres or square miles.

You can work out the area of a rectangle, like the patio above, by multiplying the long side by the short side:

width × length = area

The patio is:

6 × 3 = 18 square metres

‘Square metres’ can also be written ‘sq m’ or ‘m^2’.

Example: The area of a table

Fran sees a rectangular dining table she likes. It measures 2 m by 1.5 m. What is the area of the table?

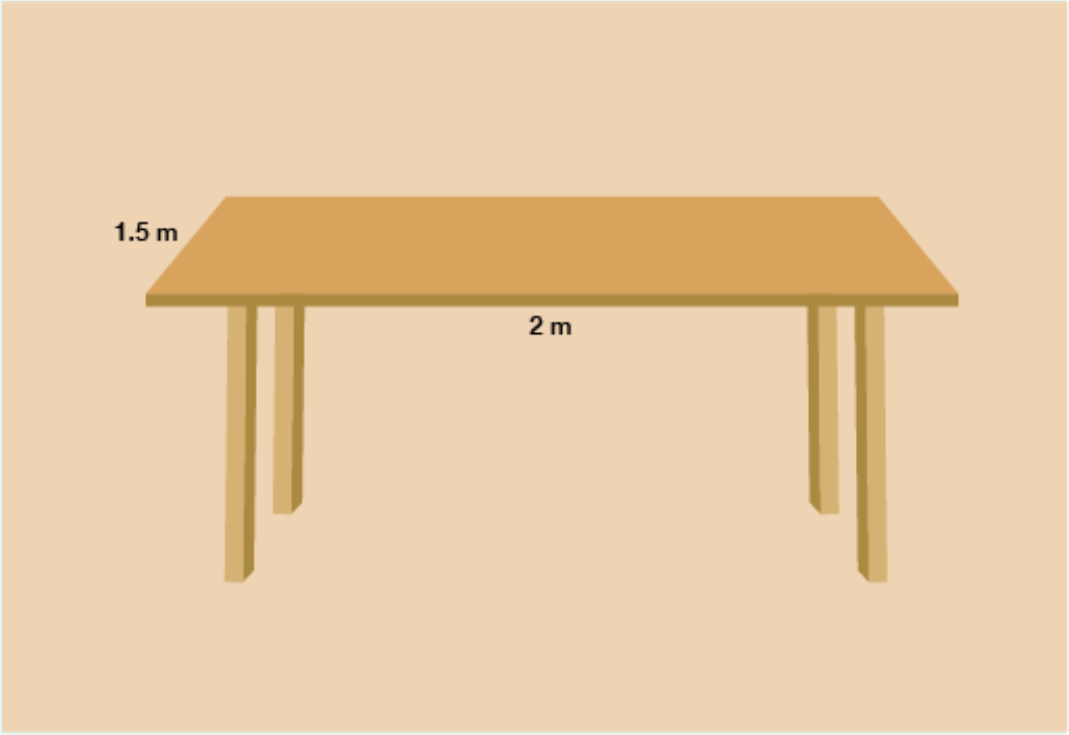


Figure 21 A dining table

Method

To find the area we need to multiply the length of the table by the width:

2 m × 1.5 m = 3 square metres

So the table is 3 m^2.

Activity 9: Area of a rectangle

Complete the following table by calculating the missing areas without using a calculator. You will have looked at methods for multiplying whole numbers and decimals in Session 1. Show your answers in correct square units.

Length	Width	Area in square units (centimetres, metres, kilometres)
80 cm	30 cm	*Provide your answer...*

7 m	4 m	*Provide your answer...*
2.5 km	2 km	*Provide your answer...*
5.5 m	2.4 m	*Provide your answer...*

Answer

Length	Width	Area in square units (centimetres, metres, kilometres)
80 cm	30 cm	2 400 cm^2
7 m	4 m	28 m^2
2.5 km	2 km	5 km^2
5.5 m	2.4 m	13.2 m^2

Hint: Always use the same units for both sides. Sometimes the length and width of the rectangle will be given in different units. They must be in the same unit before you can calculate area, so you may need to convert one side to the same units as the other side.

Example: The area of a rug

How much backing fabric is needed for this rug?

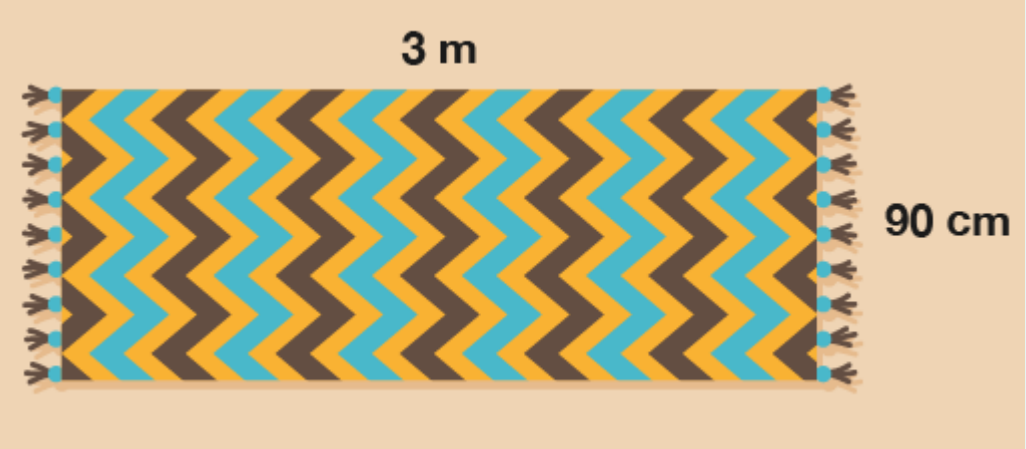


Figure 22 A rug

Method

To find the answer, you need to work out the width multiplied by the length.

90 cm × 3 m = area

First, you need to convert the width to metres so that both sides are in the same units. 90 cm is the same as 0.9 m, so the calculation is:

0.9 × 3 = area = 2.7 m^2

Now try the following activity. You need to carry out the calculations without a calculator, but you can double-check your answers on a calculator if needed. If you need a reminder about how to multiply whole numbers or decimal numbers without a calculator, please look back at Session 1 first.

Remember to check if you need to convert the measurements before calculating the area.

Activity 10: Finding the area

1. How much plastic sheeting do you need to cover this pond for the winter?

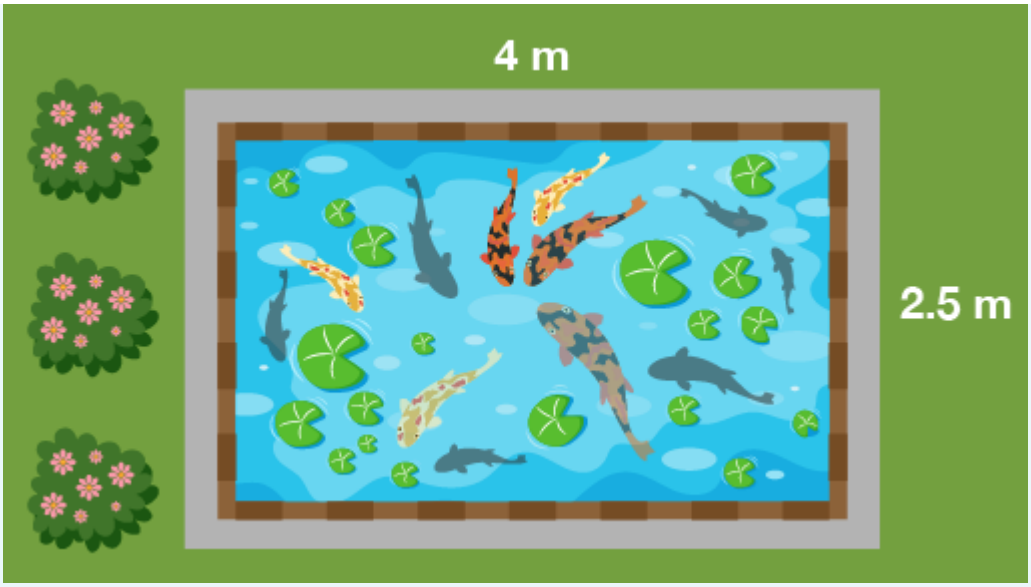


Figure 23 A pond

2. One bag of gravel will cover half a square metre of ground. How many bags do you need to cover this driveway?

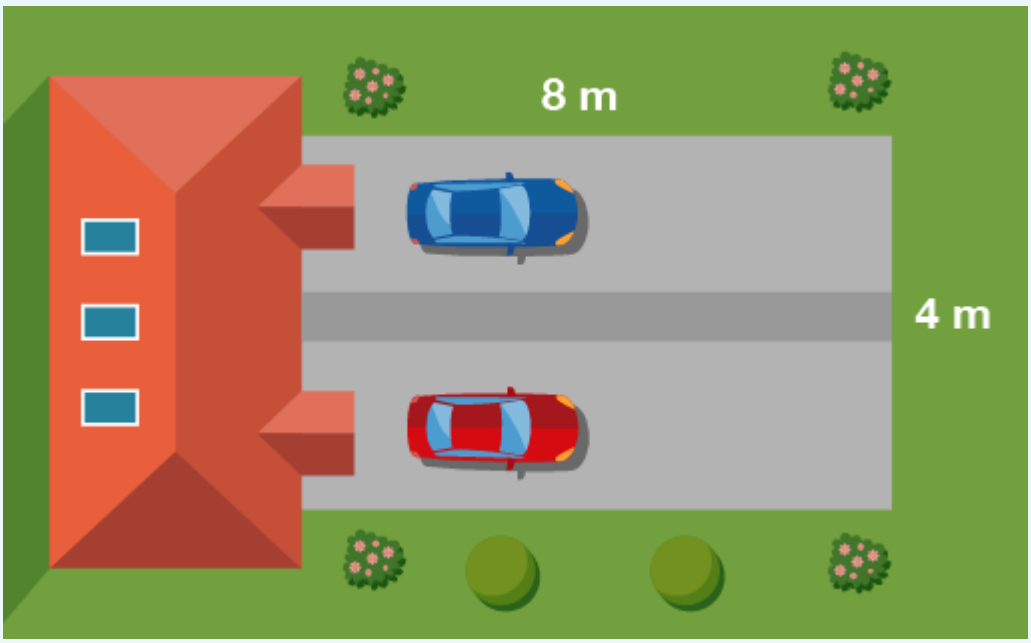


Figure 24 A driveway

3. A biologist is studying yeast growth. In the sample area shown below in purple the biologist found 80 yeast. What would go in the missing spaces in her recording sheet, as marked with a question mark?

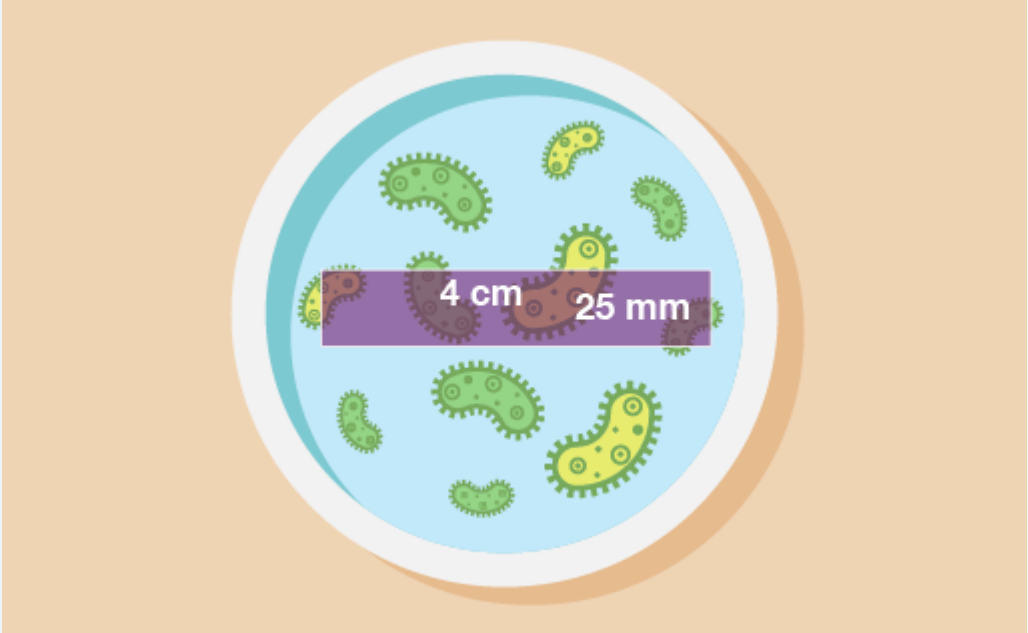


Figure 25 A petri dish

Yeast count

Sample area no.	21
Date	17 October
Yeast count	80
Sample dimensions	? cm × ? cm
Sample area	? cm^2
Yeast/cm^2	?

4. How large is this area of forestry land?

Figure 26 A forest

Answer

1. The plastic sheeting needs to be:
   $2.5 \times 4 = 10\ m^2$
2. First you need to work out the area of the driveway:
   $8 \times 4 = 32\ m^2$
   If each bag covers half a square metre, you will need two bags for each square metre:
   $32 \times 2 = 64$ bags
3. First you need to change the width to centimetres. 25 mm is the same as 2.5 cm. Then you can work out the area:
   $2.5 \times 4 = 10\ cm^2$
   There are 80 yeast, so the amount of yeast per square centimetre (yeast/cm^2) is:
   $80 \div 10 = 8$ yeast per cm^2
   The recording sheet should look like this:

Yeast count

Sample area no.	21
Date	17 October
Yeast count	80
Sample dimensions	2.5 cm × 4 cm
Sample area	10 cm^2
Yeast/cm^2	8

4. The area of forestry land is:
   4.5 × 2 = 9 square miles

Summary

In this section you have learned how to work out the area of a rectangular shape.

5 Volume

Volume is the measure of the amount of space inside of a solid (3D) object. The volume of a cube or cuboid is measured by multiplying length by width by height. It is always measured in cubic units, such as mm^3, cm^3, m^3, etc.

Example: Volume of a cuboid

What is the volume of a box with a length of 8 cm, a width of 4 cm and a height of 2 cm?

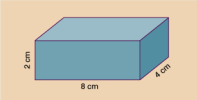


Figure 27 A box

Method

The volume is:

$$8 \text{ cm} \times 4 \text{ cm} \times 2 \text{ cm}$$

You can also write this as:

$$32 \text{ cm } (8 \text{ cm} \times 4 \text{ cm}) \times 2 \text{ cm} = 64 \text{ cm}^3$$

Watch the following clip for some more examples:

View at: youtube:M2g3KQ_Uaag

Now try the following activity.

Activity 11: Calculating volume

1. Calculate the volumes of the following:

   Hint: As with perimeter and area, you may need to convert to make the units the same.

Length	Width	Height	Volume
6 m	2 m	3 m	*Provide your answer...*
10 mm	10 mm	10 mm	*Provide your answer...*
36 mm	2 cm	4 cm	*Provide your answer...*
9 m	2 m	180 cm	*Provide your answer...*

2. A children's sandpit is 1 m wide and 1.5 m long. What volume of sand would be needed to fill the sandpit to a depth of 10 cm? (Note that depth is the same as height but measured in a downward direction.)
3. David has built a log store that measures 2 m × 1 m × 1 m. He wants to order some logs ready for the winter. The local supplier only delivers logs in 1.5 m^3 loads. Will David's store be big enough to hold one load?

Answer

1. The answer is as follows:

Length	Width	Height	Volume
6 m	2 m	3 m	36 m^3
10 mm	10 mm	10 mm	1 000 mm^3
36 mm (convert to 3.6 cm)	2 cm	4 cm	28.8 cm^3
9 m	2 m	180 cm (convert to 1.8 m)	32.4 m^3

2. First you need to convert 10 cm to metres – it's 0.1 m. Then you can calculate area:

   1 m × 1.5 m × 0.1 m = 0.15 m^3
3. The volume of David's store is 2 m × 1 m × 1 m = 2 m^3, so it will be big enough to hold one load of the logs.

Summary

In this section you have calculated the volume of cubes and cuboids.

6 Scale drawings

Have you ever drawn a plan of a room in your house to help you work out how to rearrange the furniture? Or maybe you've sketched a plan of your garden to help you decide how big a new patio should be?

These pictures are called scale drawings. The important thing with scale drawings is that everything must be drawn to scale, meaning that everything must be in proportion – that is, 'shrunk' by the same amount.

All scale drawings must have a scale to tell us how much the drawing has been shrunk by.

Example: In the garden

Here is an example of typical scale drawing:

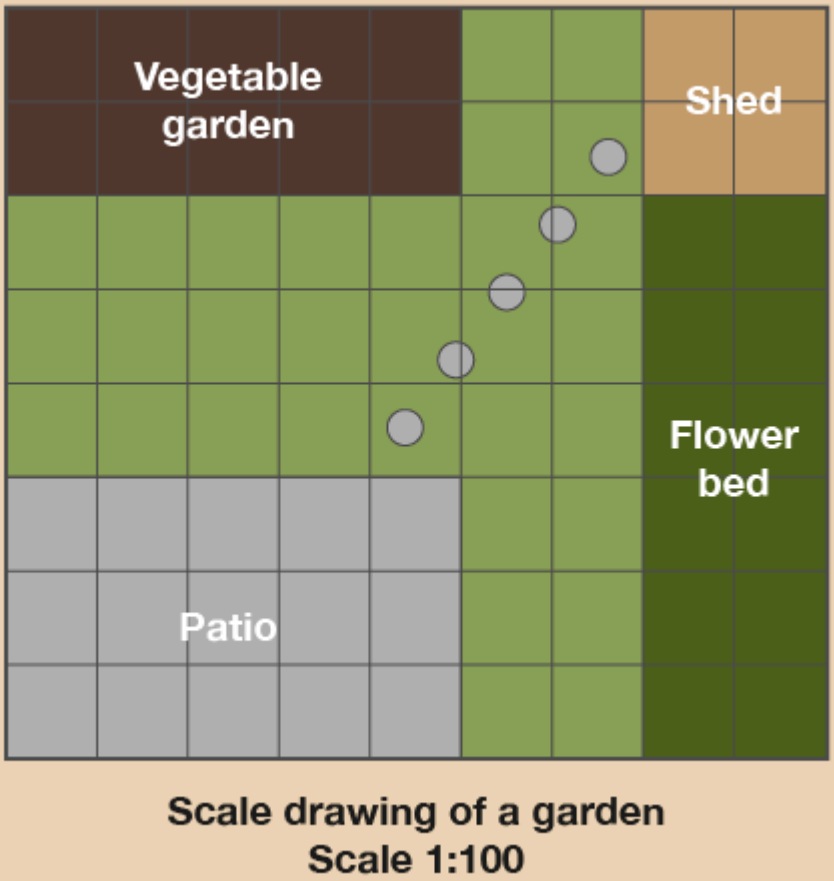


Figure 28 A scale drawing of a garden

What's the width and length of the patio?

Hint: This scale drawing has been drawn on squared paper. This makes it easier to draw and understand. Each square is 1 cm wide and 1 cm long. So instead of using a ruler you can just count the squares and this will tell you the measurement in centimetres.

Method

The scale in this drawing is 1:100. This means that 1 cm on the scale drawing is equal to 100 cm, or 1 m, in real life. Once we know the scale, we can measure the distances on the drawing.

Using a ruler (or just counting the squares), we find that the patio is 5 cm long and 3 cm wide on the drawing. This means that in real life it is 5 metres long and 3 metres wide.

So when you're working with scale drawings:

- Find out what the scale on the drawing is.
- Measure the distance on the drawing using a ruler (or count the number of squares, if that's an option). The measurements may already be given on the drawing.
- Multiply the distance you measure by the scale to give the distance in real life.
- If you already know the real-life measurement and need to work out the measurement on the drawing, you divide by the scale.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 12: Getting information from a scale drawing

1. Let's stay with this scale drawing of the garden.

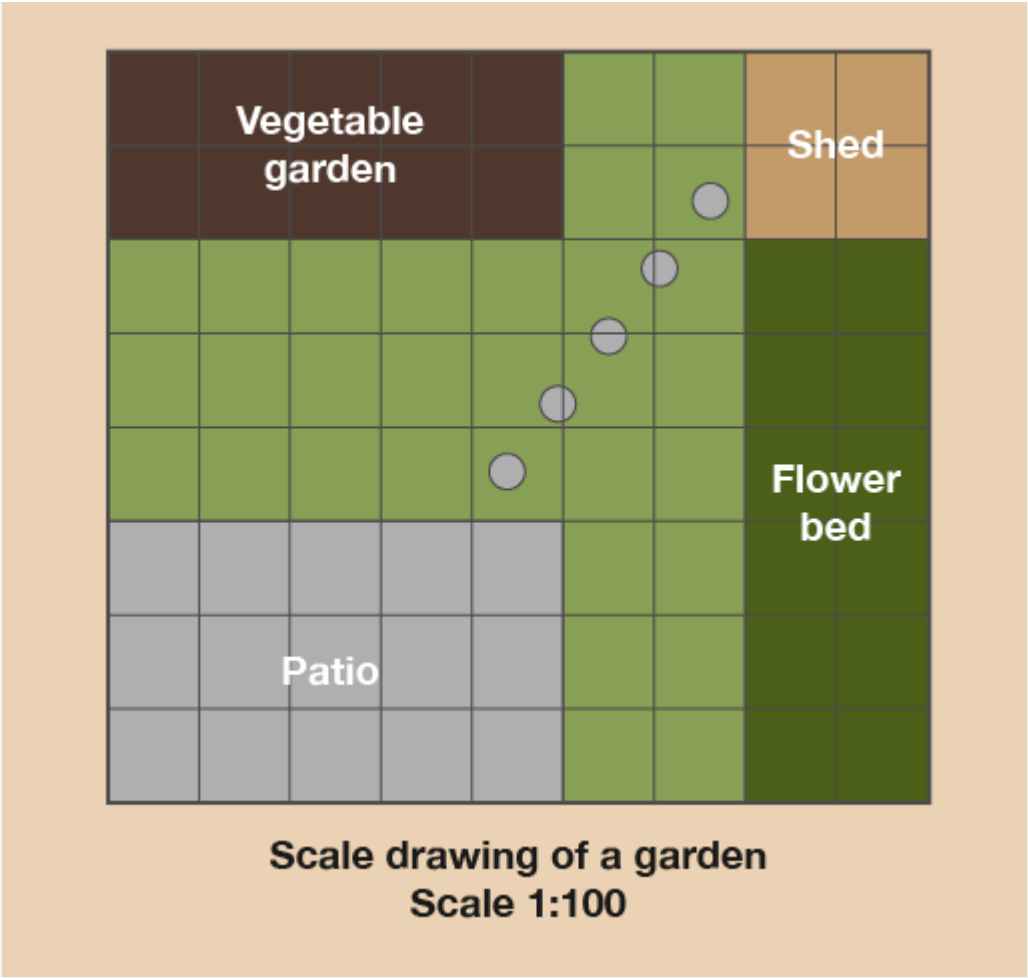


Figure 29 A scale drawing of a garden

a. What is the actual width and length of the vegetable garden?
b. What is the actual width and length of the flower bed?
c. How far is the patio from the vegetable garden in real life?
d. Say you wanted to put a trampoline between the patio and the vegetable garden. It measures 3 m by 3 m in real life. Is there enough space for it?

2. Tom is using a scale drawing to plan out a patio he is going to lay. He uses a scale of 1 cm : 50 cm. The patio on his drawing measures 4 cm by 8 cm. What are the dimensions of his actual patio?
3. Amanda is drawing a plan of the ground floor of her house, using a scale of 1 cm: 2 m. Her actual kitchen measures 5 m by 6 m. What will the measurements be for her kitchen on the plan?

Answer

1. The answers are as follows:
   a. The vegetable garden is 5 m long and 2 m wide.
   b. The flower bed is 6 m long and 2 m wide.
   c. The patio and vegetable garden are 3 m apart.

d. The distance between the patio and vegetable garden is 3 m and the trampoline is 3 m wide. So the trampoline would fit in the space, but it would be a bit of a squeeze.

2. The scale is 1 cm : 50 cm. There are two measurements to work out, so you need to do one at a time. We will start with the width of 4 cm:

1 cm : 50 cm
4 cm : ? cm

You know what the measurement on the drawing is, so you need to multiply to find the real-life measurement:

4 × 50 = 200 cm

You could then convert this measurement into metres. There are 100 cm in 1 metre, you need to divide by 100:

200 ÷ 100 = 2 m

So the width of the actual patio is 2 m.

We will now work out the length of the actual patio. The scale is the same:

1 cm : 50 cm
8 cm : ? cm

Again, you know the measurement on the drawing, so you need to multiply to find the real-life measurement:

8 × 50 = 400 cm

Again, we can divide this measurement by 100 to express it in metres:

400 ÷ 100 = 4 m

So the length of the actual patio is 4 m.

3. The scale is 1 cm : 2 m. There are two measurements to work out, so you need to do one at a time. We will start with the width of 5 m:

1 cm : 2 m
? cm : 5 m

As you know the real measurement, you need to divide to find the plan measurement:

5 ÷ 2 = 2.5 cm

We will now work out the length. The scale is the same:

1 cm : 2 m
? cm : 6 m

Again, we need to work out the plan measurement, so we need to divide:

6 ÷ 2 = 3 cm

So on the plan, her kitchen will measure 2.5 cm by 3 cm.

Summary

In this section you have learned how to use scale drawings.

7 Maps

A map gives you a detailed drawing of a place. They are used to find out how to get from one place to another. They use a scale that lets you calculate the actual distance from one place to the other.

If you look in a holiday brochure you will see lots of maps. They are often used to show how a resort is laid out. They show where a few important places are, such as local shops, hotels, the beach, swimming pools and restaurants.

It is important to understand how to read a map so that you do not end up too far from the places you want to be near – or too close to the places you want to avoid!

Example: Holiday map

Here is a typical example of a map you find in a holiday brochure.

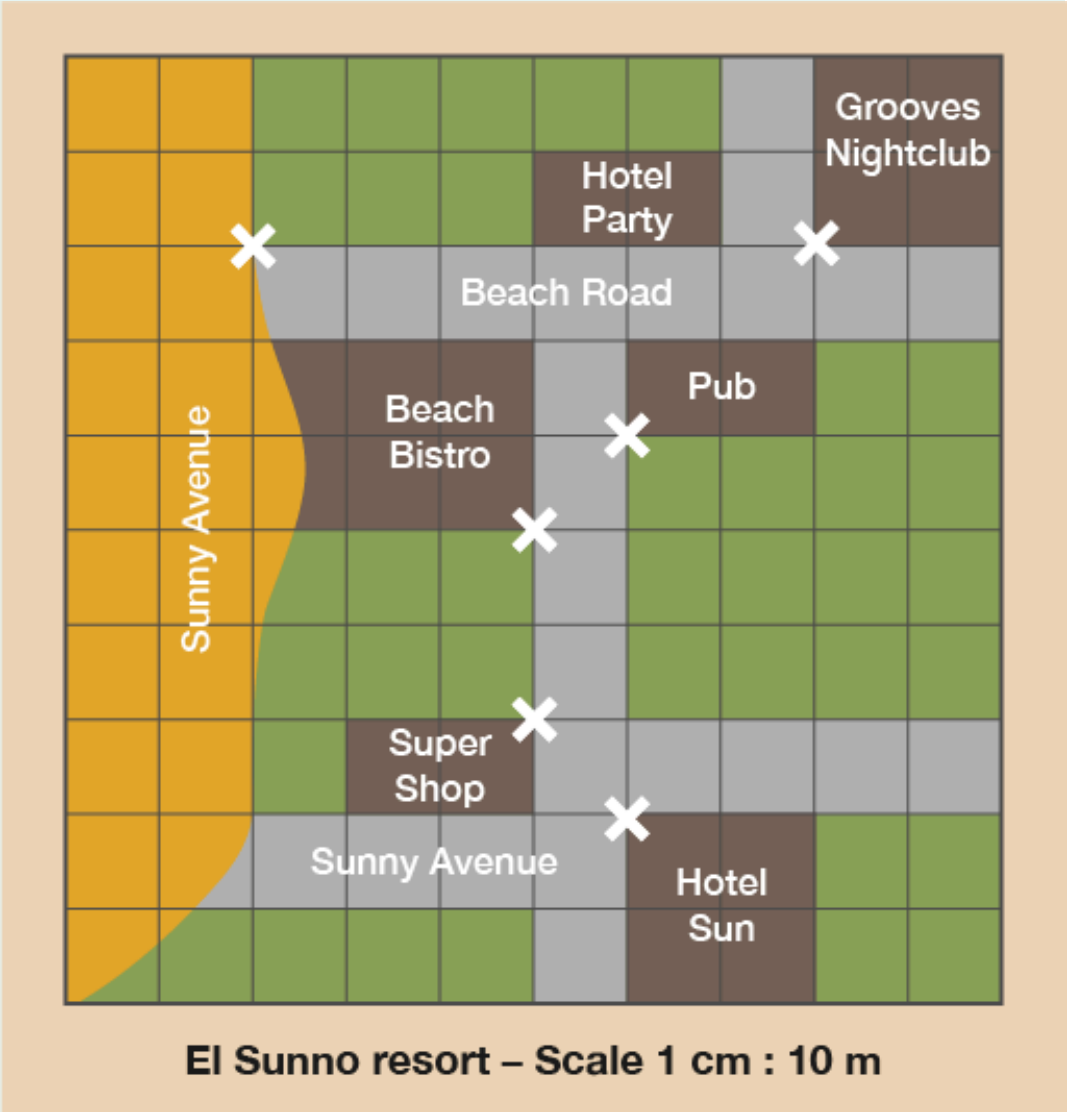


Figure 30 A scale drawing of a holiday resort

How far apart is everything on this map? Each square measures 1 cm on the map.

Method

As with scale drawings, the thing you need to know before you can understand the map is the scale and how to read it.

This means that for every 1 cm square on the map there are 10 metres (10 m) in real life.

Using the scale, you can interpret the data on the map and work out how far different places are from one another.

To do this you need to measure the distances on the map and then multiply the distances in centimetres by 10 to get the actual distance in metres.

So on this map the Grooves Nightclub is 1 cm from Hotel Party. In real life that's 10 m – not very far at all. Knowing this could affect whether you choose to stay at Hotel Party, depending on whether you like nightclubs or not.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 13: Using a map to find distances

Let's stay with the map of the holiday resort.

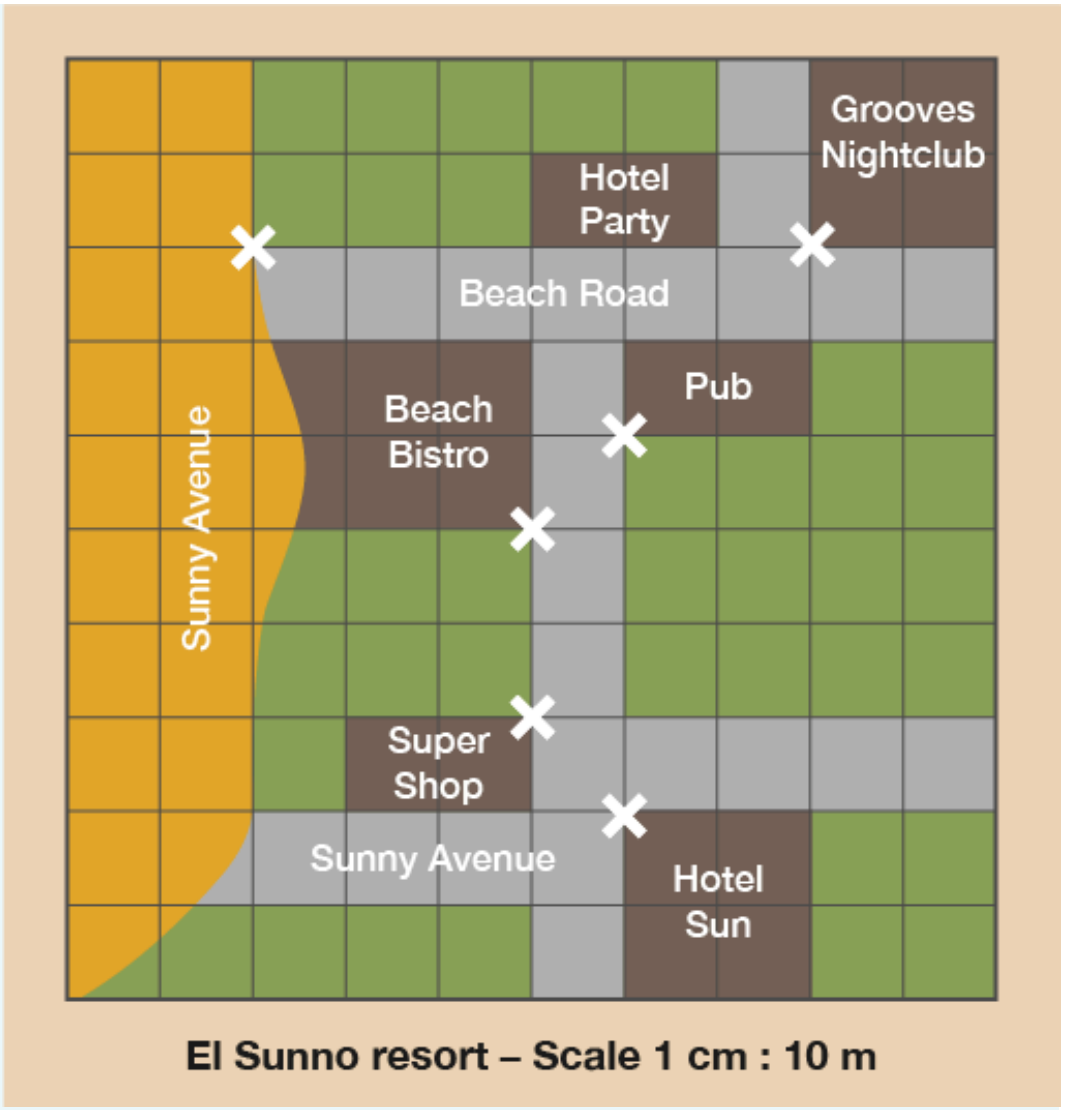


Figure 31 A scale drawing of a holiday resort

Hint: The entrances to the buildings are marked with crosses on the map. You need to measure from these crosses.

1. What is the distance in real life between the pub and Hotel Sun in metres?
2. How far is it in real life from the Super Shop to the Beach Bistro in metres?
3. What is the distance in real life from Grooves Nightclub to the beach in metres?

Now try these:

4. A map has a scale of 1 cm to 5 km. On the map, the distance between two towns measures 6 cm. What is the actual distance between the two towns? Remember to show the units in your answer.
5. A scale is given as 1 cm to 2 km. When measured on a map, the distance from the college to the bus station is 4.5 cm. What is the actual distance?

Answer

1. The distance on the map between the pub and Hotel Sun is 4 cm, and the scale is 1 cm : 10 m. Because you need to work out the real measurement, you need to multiply the map measurement by 10:

   4 cm × 10 = 40

   The actual distance in real life between the pub and Hotel Sun is 40 m.
2. The distance on the map is 2 cm. Using the same calculation, the actual distance in real life between the Super Shop and the Beach Bistro is 20 m.
3. The distance on the map is 6 cm. Using the same calculation, the actual distance in real life between Grooves nightclub and the beach is 60 m.
4. The scale is 1 cm to 5 km. The distance on the map is 6 cm, so multiply 6 × 5 km to give an answer of 30 km.
5. The scale is 1 cm to 2 km. The distance on the map is 4.5 cm, so multiply 4.5 × 2 km to give an answer of 9 km.

Summary

In this section you have learned how to use maps.

8 End-of-course 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 down the ‘Ctrl’ key [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, ‘Shape and space’. 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:

- work out the perimeter of your garden for fencing
- find out how much carpet you need to re-carpet a room or floor
- work out how much gravel you need to cover a driveway
- work out the volume of a sandpit or storage room
- use a simple scale on a plan of a garden or holiday resort
- read maps to calculate distances from one place to another.

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 4.

Session 4: Handling data

Introduction

You are surrounded by information every day. You'll often have to analyse different forms of information without realising that you are doing it. This information, or data, could be presented to you in television programmes, newspapers, magazines or timetables, and can be presented in different ways, such as in tables, charts, diagrams or graphs. Election results are often reported using different methods to display the results.

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

- collect and record data, and then organize and represent it in different ways
- find information in tables, diagrams, charts, and understand what it means
- find the mean and range of a set of numbers
- use data to assess how likely something is to happen.

Video content is not available in this format.

1 Collecting data

In the introduction we mentioned the different ways you can display information – for example, in tables, diagrams, charts or graphs. Before you can create any of these, however, you need to collect the information to put in them.

One way of collecting information is through a survey. Have you ever been stopped in the street by someone doing a survey, or filled one in online?

You'll often see surveys by YouGov, which is one example of a market research and data company, referred to on TV news programmes or in newspapers. YouGov commissions surveys on various topics, including the following (which you may want to open in a new window or tab):

- the public's voting intention if there was a General Election held tomorrow
- the next actor to play James Bond
- how often we check our mobile phones
- people's preference for dealing with climate change.

Note from these examples how survey results can be presented in different ways.

A survey is a method of collecting data. But once you've collected the data, it needs to be organised and displayed in a way that's easy to understand.

This is something that's straightforward to do with discrete data – that is, data made up of things that are separate and can be counted. For example:

- the number of people on a bus
- the number of cars in a car park
- the number of leaves on a tree.

A tally chart is a useful way of collecting information. A tally chart consists of a series of tallies. It works like this:

- For each thing, or unit, that you count – each person on a bus, each car in a car park, each leaf on a tree, or whatever – you make a tally mark like this:

- When you count up to five units, you 'cross out' the other four tally marks like this:

- You then continue to count units in groups of fives, as follows:

   = 4

   = 5

   = 6

   = 10

Note: You might have heard of something called a tally table. Tally charts and tally tables are the same thing.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 1: Rewriting numbers as tallies

Write the following numbers in tally form:

1. 3
2. 7
3. 9
4. 14
5. 18

Answer

1. 𝍸
2. 𝍸 ||
3. 𝍸 ||||
4. 𝍸 𝍸 ||||
5. 𝍸 𝍸 𝍸 |||

Example: Using a tally chart

You can use tally charts to record data when you carry out surveys and collect data.

Have you ever seen people at the side of a road doing a traffic survey? They could be recording the number of people in each car, and at the end of the survey they could add up the tallies and record the totals. Their tally chart would look something like this:

Number of people in car	Number of cars	Total number of cars
1	𝍸	4
2					3
3			1

4	II	2
5+	I	1

So why use tally charts? It's because they're a quick and simple way of recording data.

Now try the following activities. Remember to check your answers once you have completed the questions.

Hint: Tick or cross off each entry as you put it into your tally chart. This will help you stop losing your place.

Activity 2: Creating a tally chart

Twenty people were asked in a survey how many people lived in their house. These were the answers:

2	3	1	4	3
2	3	2	1	2
1	3	4	2	2
3	1	3	2	2

Use the information in the table above to create your own tally chart of how many people live in a house. Your tally chart should be arranged as follows:

Number of people in the house	Number of responses

Answer

Number of people in the house	Number of responses
1	IIII

2	
3	
4	

Activity 3: Creating a tally chart

The following information is a record of the colours of cars in a car park one lunchtime:

red	yellow	red	blue	white
blue	black	white	red	green
red	white	green	black	blue
white	blue	red	red	black

Draw a tally chart to present the data.

Answer

Your table should look like this:

Number of cars with certain colours in a car park one lunchtime

Colour of car	Number of cars	Total
Black		3
Blue		4
Green		2
Red		6
White		4
Yellow		1

> Notice how the tally chart has a title. It is important to give every table, graph or chart you produce an overall title.

Summary

In this section you have learned about how tally charts are used.

2 Handling data

What does handling data mean?

A dictionary gives the following definitions:

- **Handle:** To use, operate, manage.
- **Data:** Facts, especially numerical facts, collected together for reference or information.

So, the phrase ‘handling data’ means being able to read, understand and interpret facts and figures.

You do this every day if you look at bus and train timetables, or diagrams, charts and graphs. All of these show complex information as simply as possible.

In fact, you’re surrounded by mountains of data! If you book a holiday using a brochure, this is full of data that you need to understand. For example:

- tables that show price lists
- maps or diagrams to show where the resort is or the distance to the airport
- charts and graphs to show temperatures and hours of sunshine.

The brochure may provide all the information you need to compare holidays and pick the one you want. If you can, look through a holiday brochure and see for yourself: the tables, charts, graphs and diagrams make the information easier to understand.

2.1 Reading tables

Look at the following example from a brochure. Being able to understand the table is important because that will help you to pick the skiing holiday that suits you best.

Figure 1 Which holiday suits you best?

Example: The weather

If you look in a newspaper, it will probably have a section that tells you the weather forecast. It might even have this information in a table that looks like this:

Weather update

Location	Today			Tomorrow		
	Weather	Min. temp. (°C/°F)	Max. temp. (°C/°F)	Weather	Min. temp. (°C/°F)	Max. temp. (°C/°F)
South and southwest		22/72	27/81		16/61	21/70
Midlands		22/72	28/82		24/75	31/88
Scotland		20/68	24/75		19/66	21/70

Wales		15/59	19/66		17/63	21/70
Northern Ireland		18/64	24/75		21/70	27/81

This could have been written out like this:

> The weather today in the south, southwest, Midlands and Scotland will be sunny. In Wales there will be showers and in Northern Ireland there will be storms. Tomorrow it will be sunny, with showers in the south and southwest. It will be sunny in the Midlands and Northern Ireland, and there will be storms in Scotland and Wales.

Can you see how displaying the information in table form made it easier to understand? Tables are made up of rows and columns. Rows are horizontal (that is, they go across the page) and the columns are vertical (up and down).

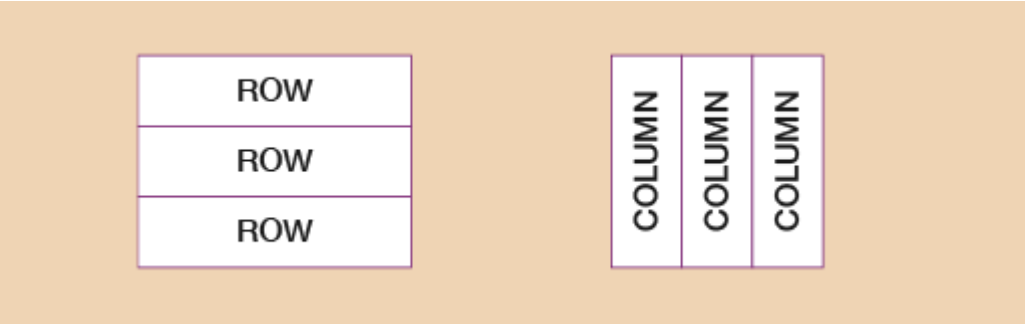


Figure 2 Rows and tables

To make sense of a table you need to have three things:

1. **A title** that tells you what the table is about. In this table the title is ‘Weather update’.
2. **Row headings** that tell you what is in each row. In the weather table the row headings are:
   - South and southwest
   - Midlands
   - Scotland
   - Wales
   - Northern Ireland
3. **Column headings** that tell you what is in each column. In the weather table the column headings are:
   - Location
   - Today
   - Tomorrow

Tables can be very big, with many rows and columns – it depends how much information you are displaying.

For example, in a bus or train station you will see a huge timetable on the wall with many rows and columns. It is supposed to make the data easier to understand, but it is still complicated and easy to get confused.

Timetables often use the 24-hour clock. If you are not familiar with this, please see the section on time in Session 2 before you try these activities.

Example: A bus timetable

Look at the following page from a bus timetable:

Mondays to Friday except public holidays

Banbury Bridge Street stand 2	0615	0630	0645	0700	0715	0730	0745	0800	0812	0824	0836	0848	then every 12 mins at	00	12	24	36	48	until
Woodgreen Avenue	0624	0639	0654	0709	0724	0739	0754	0809	0821	0833	0845	0857		09	21	33	45	57	
Bradley Arcade	0628	0643	0658	0713	0728	0743	0758	0813	0825	0837	0849	0901		13	25	37	49	01	
The Fairway Sandford Grn	0631	0646	0701	0716	0731	0746	0801	0817	0829	0841	0853	0905		17	29	41	53	05	
Banbury Bridge Street	0640	0655	0710	0725	0740	0755	0810	0827	0839	0851	0903	0915		27	39	51	03	15	
Banbury Bridge Street stand 2	1700	1712	1724	1740	1755	1815	1830	1900	then every 30 mins at	30	00	until	2330						
Woodgreen Avenue	1709	1721	1733	1749	1804	1824	1839	1909		39	09		2339						
Bradley Arcade	1713	1725	1737	1753	1808	1828	1843	1913		43	13		2343						
The Fairway Sandford Grn	1717	1729	1741	1757	1812	1832	1846	1916		46	16		2346						
Banbury Bridge Street	1727	1739	1751	1807	1822	1842	1855	1925		55	25		2355						

Figure 3 A bus timetable

Mr Newman would like to catch a bus from Woodgreen Avenue to visit his son in Bridge Street, in Banbury. He would like to get there before 8:45 a.m. What's the latest bus he can catch to arrive at his son's house in time?

Method

The latest bus he could catch is the 8:21 a.m. bus from Woodgreen Avenue, which would arrive at his son's house at 8:39 a.m.

To work this out, you start by looking at which bus arrives at Bridge Street before 8:45 a.m. Following the row across from Bridge Street in the left-hand column, you can see that a bus arrives at 8:39 a.m. (The next bus arrives at 8:51 a.m., which is too late.) You then need to look up this column to find out what time this bus leaves Woodgreen Avenue, which is 8:21 a.m.

Mondays to Friday except public holidays

Banbury Bridge Street stand 2	0615	0630	0645	0700	0715	0730	0745	0800	0812	0824	0836	0848	then every 12 mins at	00	12	24	36	48	until
Woodgreen Avenue	0624	0639	0654	0709	0724	0739	0754	0809	0821	0833	0845	0857		09	21	33	45	57	
Bradley Arcade	0628	0643	0658	0713	0728	0743	0758	0813	0825	0837	0849	0901		13	25	37	49	01	
The Fairway Sandford Grn	0631	0646	0701	0716	0731	0746	0801	0817	0829	0841	0853	0905		17	29	41	53	05	
Banbury Bridge Street	0640	0655	0710	0725	0740	0755	0810	0827	0839	0851	0903	0915		27	39	51	03	15	
Banbury Bridge Street stand 2	1700	1712	1724	1740	1755	1815	1830	1900	then every 30 mins at	30	00	until	2330						
Woodgreen Avenue	1709	1721	1733	1749	1804	1824	1839	1909		39	09		2339						
Bradley Arcade	1713	1725	1737	1753	1808	1828	1843	1913		43	13		2343						
The Fairway Sandford Grn	1717	1729	1741	1757	1812	1832	1846	1916		46	16		2346						
Banbury Bridge Street	1727	1739	1751	1807	1822	1842	1855	1925		55	25		2355						

Figure 4 A bus timetable (answer)

Activity 4: Reading a bus timetable

Use the same timetable to answer the following question:

Sian has to attend an interview at The Fairway at 9 a.m. What time should she leave Woodgreen Avenue?

Hint: Use the method described in the last activity.

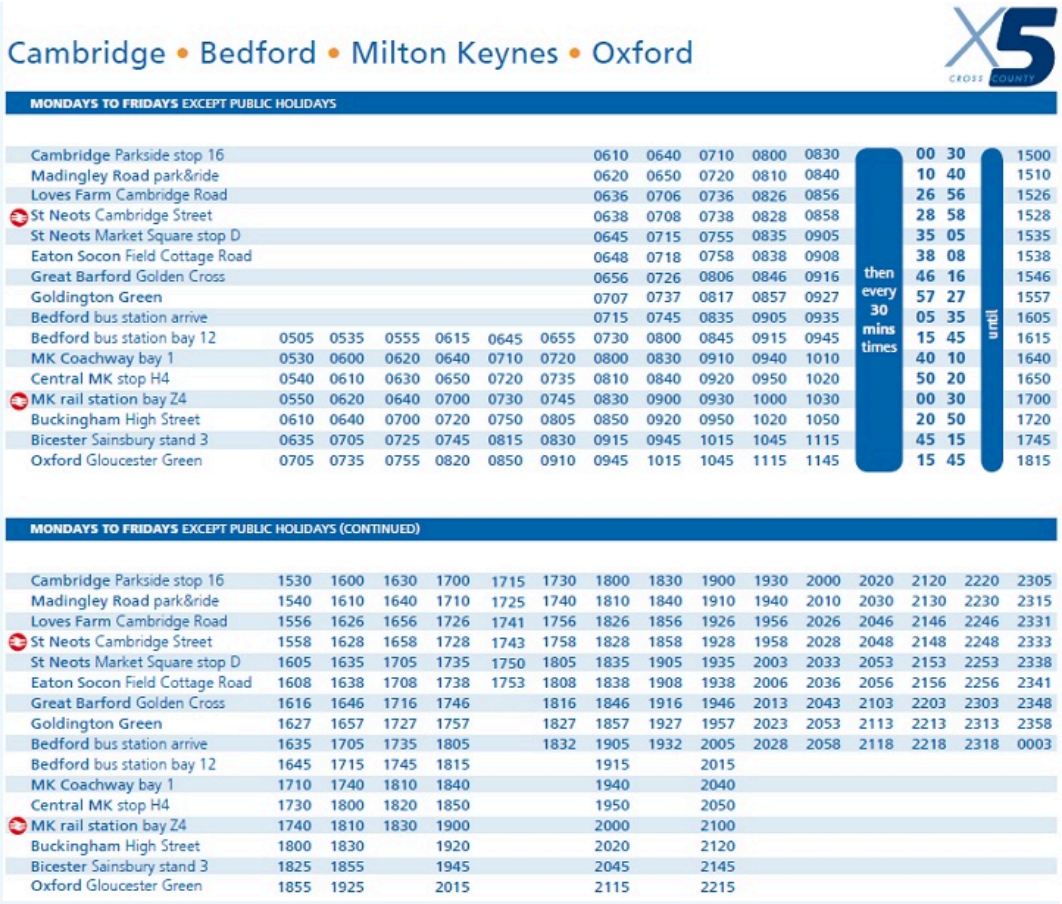
Answer

A bus arrives at the Fairway at 8:53 a.m., so Sian would need to catch this bus from Woodgreen Avenue at 8:45 a.m. If she caught the 8:57 a.m. bus from Woodgreen Avenue, she would not get to the Fairway until after 9 a.m.

Activity 5: Reading another bus timetable

Look at another bus timetable in Figures 5a and 4b, and answer the questions that follow.

Hint: Make sure you look at the headings to see the days of the week to which each section of the timetable applies.



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MONDAYS TO FRIDAYS EXCEPT PUBLIC HOLIDAYS

Cambridge Parkside stop 16							0610	0640	0710	0800	0830	then every 30 mins times	00	30	until	1500
Madingley Road park&ride							0620	0650	0720	0810	0840		10	40		1510
Loves Farm Cambridge Road							0636	0706	0736	0826	0856		26	56		1526
St Neots Cambridge Street							0638	0708	0738	0828	0858		28	58		1528
St Neots Market Square stop D							0645	0715	0755	0835	0905		35	05		1535
Eaton Socon Field Cottage Road							0648	0718	0758	0838	0908		38	08		1538
Great Barford Golden Cross							0656	0726	0806	0846	0916		46	16		1546
Goldington Green							0707	0737	0817	0857	0927		57	27		1557
Bedford bus station arrive							0715	0745	0835	0905	0935		05	35		1605
Bedford bus station bay 12	0505	0535	0555	0615	0645	0655	0730	0800	0845	0915	0945		15	45		1615
MK Coachway bay 1	0530	0600	0620	0640	0710	0720	0800	0830	0910	0940	1010		40	10		1640
Central MK stop H4	0540	0610	0630	0650	0720	0735	0810	0840	0920	0950	1020		50	20		1650
MK rail station bay Z4	0550	0620	0640	0700	0730	0745	0830	0900	0930	1000	1030		00	30		1700
Buckingham High Street	0610	0640	0700	0720	0750	0805	0850	0920	0950	1020	1050		20	50		1720
Bicester Sainsbury stand 3	0635	0705	0725	0745	0815	0830	0915	0945	1015	1045	1115		45	15		1745
Oxford Gloucester Green	0705	0735	0755	0820	0850	0910	0945	1015	1045	1115	1145		15	45		1815

MONDAYS TO FRIDAYS EXCEPT PUBLIC HOLIDAYS (CONTINUED)

Cambridge Parkside stop 16	1530	1600	1630	1700	1715	1730	1800	1830	1900	1930	2000	2020	2120	2220	2305
Madingley Road park&ride	1540	1610	1640	1710	1725	1740	1810	1840	1910	1940	2010	2030	2130	2230	2315
Loves Farm Cambridge Road	1556	1626	1656	1726	1741	1756	1826	1856	1926	1956	2026	2046	2146	2246	2331
St Neots Cambridge Street	1558	1628	1658	1728	1743	1758	1828	1858	1928	1958	2028	2048	2148	2248	2333
St Neots Market Square stop D	1605	1635	1705	1735	1750	1805	1835	1905	1935	2003	2033	2053	2153	2253	2338
Eaton Socon Field Cottage Road	1608	1638	1708	1738	1753	1808	1838	1908	1938	2006	2036	2056	2156	2256	2341
Great Barford Golden Cross	1616	1646	1716	1746		1816	1846	1916	1946	2013	2043	2103	2203	2303	2348
Goldington Green	1627	1657	1727	1757		1827	1857	1927	1957	2023	2053	2113	2213	2313	2358
Bedford bus station arrive	1635	1705	1735	1805		1832	1905	1932	2005	2028	2058	2118	2218	2318	0003
Bedford bus station bay 12	1645	1715	1745	1815			1915		2015						
MK Coachway bay 1	1710	1740	1810	1840			1940		2040						
Central MK stop H4	1730	1800	1820	1850			1950		2050						
MK rail station bay Z4	1740	1810	1830	1900			2000		2100						
Buckingham High Street	1800	1830		1920			2020		2120						
Bicester Sainsbury stand 3	1825	1855		1945			2045		2145						
Oxford Gloucester Green	1855	1925		2015			2115		2215						

Figure 5a A bus timetable

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SATURDAYS EXCEPT PUBLIC HOLIDAYS

Cambridge Parkside stop 16								0700	0730	then every 30 mins times	00	30	until	1600	1630	1700
Madingley Road park&ride								0710	0740		10	40		1610	1640	1710
Loves Farm Cambridge Road								0726	0756		26	56		1626	1656	1726
St Neots Cambridge Street								0728	0758		28	58		1628	1658	1728
St Neots Market Square stop D								0735	0805		35	05		1635	1705	1735
Eaton Socon Field Cottage Road								0738	0808		38	08		1638	1708	1738
Great Barford Golden Cross								0746	0816		46	16		1646	1716	1746
Goldington Green								0757	0827		57	27		1657	1727	1757
Bedford bus station arrive								0805	0835		05	35		1705	1735	1805
Bedford bus station bay 12	0505	0535	0555	0615	0645	0715	0745	0815	0845		15	45		1715	1745	1815
MK Coachway bay 1	0530	0600	0620	0640	0710	0740	0810	0840	0910		40	10		1740	1810	1840
Central MK stop H4	0540	0610	0630	0650	0720	0750	0820	0850	0920		50	20		1750	1820	1850
MK rail station bay Z4	0550	0620	0640	0700	0730	0800	0830	0900	0930		00	30		1800	1830	1900
Buckingham High Street	0610	0640	0700	0720	0750	0820	0850	0920	0950		20	50		1820		1920
Bicester Sainsbury stand 3	0635	0705	0725	0745	0815	0845	0915	0945	1015		45	15		1845		1945
Oxford Gloucester Green	0705	0735	0755	0815	0845	0915	0945	1015	1045		15	45		1915		2015

SATURDAYS EXCEPT PUBLIC HOLIDAYS (CONTINUED)

Cambridge Parkside stop 16	1730	1800	1830	1900	1930	2000	2020	2120	2220	2305
Madingley Road park&ride	1740	1810	1840	1910	1940	2010	2030	2130	2230	2315
Loves Farm Cambridge Road	1756	1826	1856	1926	1956	2026	2046	2146	2246	2331
St Neots Cambridge Street	1758	1828	1858	1928	1958	2028	2048	2148	2248	2333
St Neots Market Square stop D	1805	1835	1905	1935	2003	2033	2053	2153	2253	2338
Eaton Socon Field Cottage Road	1808	1838	1908	1938	2006	2036	2056	2156	2256	2341
Great Barford Golden Cross	1816	1846	1916	1946	2013	2043	2103	2203	2303	2348
Goldington Green	1827	1857	1927	1957	2023	2053	2113	2213	2313	2358
Bedford bus station arrive	1832	1905	1932	2005	2028	2058	2118	2218	2318	0003
Bedford bus station bay 12		1915		2015						
MK Coachway bay 1		1940		2040						
Central MK stop H4		1950		2050						
MK rail station bay Z4		2000		2100						
Buckingham High Street		2020		2120						
Bicester Sainsbury stand 3		2045		2145						
Oxford Gloucester Green		2115		2215						

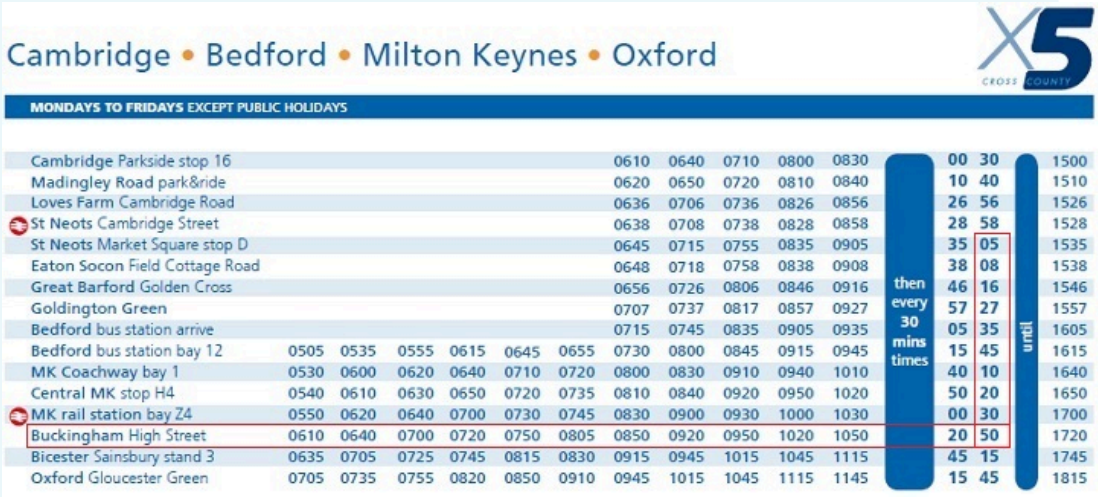
Figure 5b A bus timetable

1. What time does the first bus leave Parkside stop 16 in Cambridge on a Tuesday?
2. What time does the last bus leave Madingley Road's park and ride on a Saturday?
3. David wants to meet a friend at Milton Keynes train station on Thursday at 9 a.m. What time should he leave Goldington Green? (**Hint:** Milton Keynes is shortened to 'MK' on the timetable, and train stations are shown using the rail logo in a red circle.)
4. On Monday, Susan arrives at Market Square stop D in St Neots at 10:45 a.m. What time is the next bus to Buckingham High Street, and how long will the journey take?

Answer

1. The first bus leaves Parkside stop 16 in Cambridge on a Tuesday at 6:10 a.m. (which is written as '0610' on the timetable).
2. The last bus leave Madingley Road's park and ride on a Saturday at 11:15 p.m. (which is written as '2315' on the timetable).
3. He should leave Goldington Green on the 7:37 a.m. bus, which arrives at Milton Keynes at 9 a.m.
4. After 9:05 a.m. on a Monday, buses arrive at the Market Square stop D in St Neots every 30 minutes at five minutes past and 35 minutes past each hour. So if Susan arrives at the stop at 10:45 a.m., the next bus will be at 11:05 a.m.

The bus arrives at Buckingham High Street at 12:50 p.m. To work this out, follow the minutes column down from the 05 (see timetable below) to the row for Buckingham High Street, where it shows 50 minutes past. However, this does not mean that the bus arrives 45 minutes later. If you look at the stops, you see the bus also stops at 8 minutes past, and then 16, 27, 35 and 45 minutes past; then it goes down to 10 minutes past, and then 20 and 30 minutes past before Susan's stop at 50 minutes past. If you look at these times, you see that the bus travels for more than an hour, so the journey takes 1 hour and 45 minutes, or 105 minutes. (Another way to check this is to look at the journey times of an earlier bus where all times are shown in full: for example, the bus that arrives at Market Square stop D in St Neots at 9:05 a.m. arrives at Buckingham High Street at 10:50 a.m.)



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X5 CROSS COUNTY

MONDAYS TO FRIDAYS EXCEPT PUBLIC HOLIDAYS

Cambridge Parkside stop 16							0610	0640	0710	0800	0830	then every 30 mins times	00	30	until 1500
Madingley Road park&ride							0620	0650	0720	0810	0840		10	40	1510
Loves Farm Cambridge Road							0636	0706	0736	0826	0856		26	56	1526
St Neots Cambridge Street							0638	0708	0738	0828	0858		28	58	1528
St Neots Market Square stop D							0645	0715	0755	0835	0905		35	05	1535
Eaton Socon Field Cottage Road							0648	0718	0758	0838	0908		38	08	1538
Great Barford Golden Cross							0656	0726	0806	0846	0916		46	16	1546
Goldington Green							0707	0737	0817	0857	0927		57	27	1557
Bedford bus station arrive							0715	0745	0835	0905	0935		05	35	1605
Bedford bus station bay 12	0505	0535	0555	0615	0645	0655	0730	0800	0845	0915	0945		15	45	1615
MK Coachway bay 1	0530	0600	0620	0640	0710	0720	0800	0830	0910	0940	1010		40	10	1640
Central MK stop H4	0540	0610	0630	0650	0720	0735	0810	0840	0920	0950	1020		50	20	1650
MK rail station bay Z4	0550	0620	0640	0700	0730	0745	0830	0900	0930	1000	1030		00	30	1700
Buckingham High Street	0610	0640	0700	0720	0750	0805	0850	0920	0950	1020	1050		20	50	1720
Bicester Sainsbury stand 3	0635	0705	0725	0745	0815	0830	0915	0945	1015	1045	1115		45	15	1745
Oxford Gloucester Green	0705	0735	0755	0820	0850	0910	0945	1015	1045	1115	1145		15	45	1815

Figure 6 A bus timetable (answer)

Now try the following activities. Remember to check your answers once you have completed the questions.

Activity 6: A trip to the library

The local library has the following opening times:

Day	Opening time	Closing time
Monday	9:30	12:30
Tuesday	12:30	5:30
Wednesday	9:30	5:30
Thursday	9:30	12:30
Friday	9:30	5:30

Saturday	9:30	12:30
Sunday	*Closed*	

1. When is the library open all day?
2. When is the library open only in the afternoon?

Answer

1. The library is open all day on Wednesday and Friday.
2. The library is open only in the afternoon on Tuesday.

Activity 7: The waiter's shift

At the end of his shift a waiter drew up the following table to work out how many drinks he had served:

Drinks	Number served
Tea	𝍸 I
Coffee	𝍸 II
Orange juice	II
Hot chocolate	III
Coke	𝍸

1. The table does not have a title. What would be a suitable title?
2. What are the row headings and column headings?
3. How many Cokes did the waiter serve?
4. How many cold drinks did the waiter serve?
5. How many drinks did the waiter serve all together?

Answer

1. A suitable title would be something like 'Drinks served during shift'.
2. The row headings are 'Tea', 'Coffee', 'Orange juice', 'Hot chocolate' and 'Coke'. The column headings are 'Drinks' and 'Number served'.
3. The waiter served five Cokes.
4. The waiter served two orange juices and five Cokes, making seven cold drinks in total.

5. The waiter served 6 + 7 + 2 + 3 + 5 = 23 drinks in total.

Summary

In this section you have learned about handling data, and specifically, how to present data in tables.

3 Pictograms

One very simple way of showing data is in pictograms, which use pictures to count with. Pictograms have a strong visual impact.

As with tables, you need to decide on your title and what each row of the pictogram means. You also need to decide on your key. The key tells your reader what the picture you are using means.

The following pictogram shows the number of cars using a car wash at different times during the week:

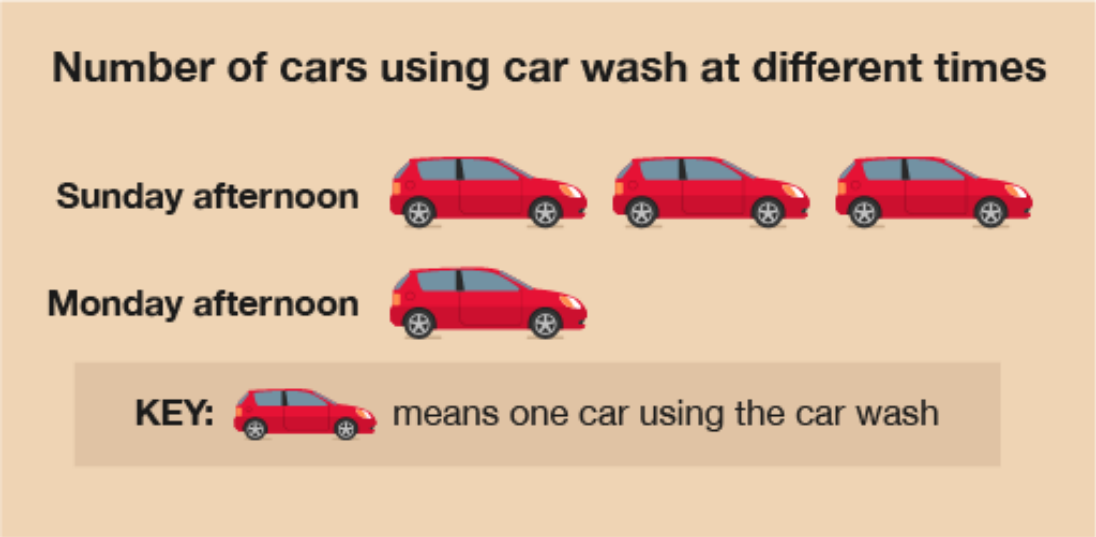


Figure 7 Car wash pictogram

The important thing to remember with pictograms is that there must be a key to tell the reader what the picture means. In the example above, the picture of one car means one car used the car wash. But in the next example, showing the number of people buying petrol from a garage between 2 and 3 p.m. on a Sunday and Monday afternoon, the key is used differently:

Figure 8 Petrol pictogram

Every pictogram needs a key – but this one doesn't have one! You might think that  means one person buying petrol.

In fact,  means four people buying petrol and  means three people buying petrol.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 8: Deciphering a key

Can you work out what  and mean?

Answer

 means two people buying petrol and means one person buying petrol.

So the key can be used to show more than one item. This could be done to make the drawing of the pictogram easier when working with bigger numbers.

It is important to make sure you understand what the key means so that you can understand the data correctly.

There are advantages and disadvantages to using pictograms. On the one hand, they are easy to understand. On the other hand, however, they can only show a few things.

Activity 9: Creating a pictogram

The following table shows the number of people queueing at a local post office at different times of the day:

Time	Number
9 a.m.	4
11 a.m.	2
1 p.m.	7
3 p.m.	1
5 p.m.	3

Show this information as a pictogram using an appropriate key, for example where an envelope represents two people.

Answer

Does your pictogram look like the one below?

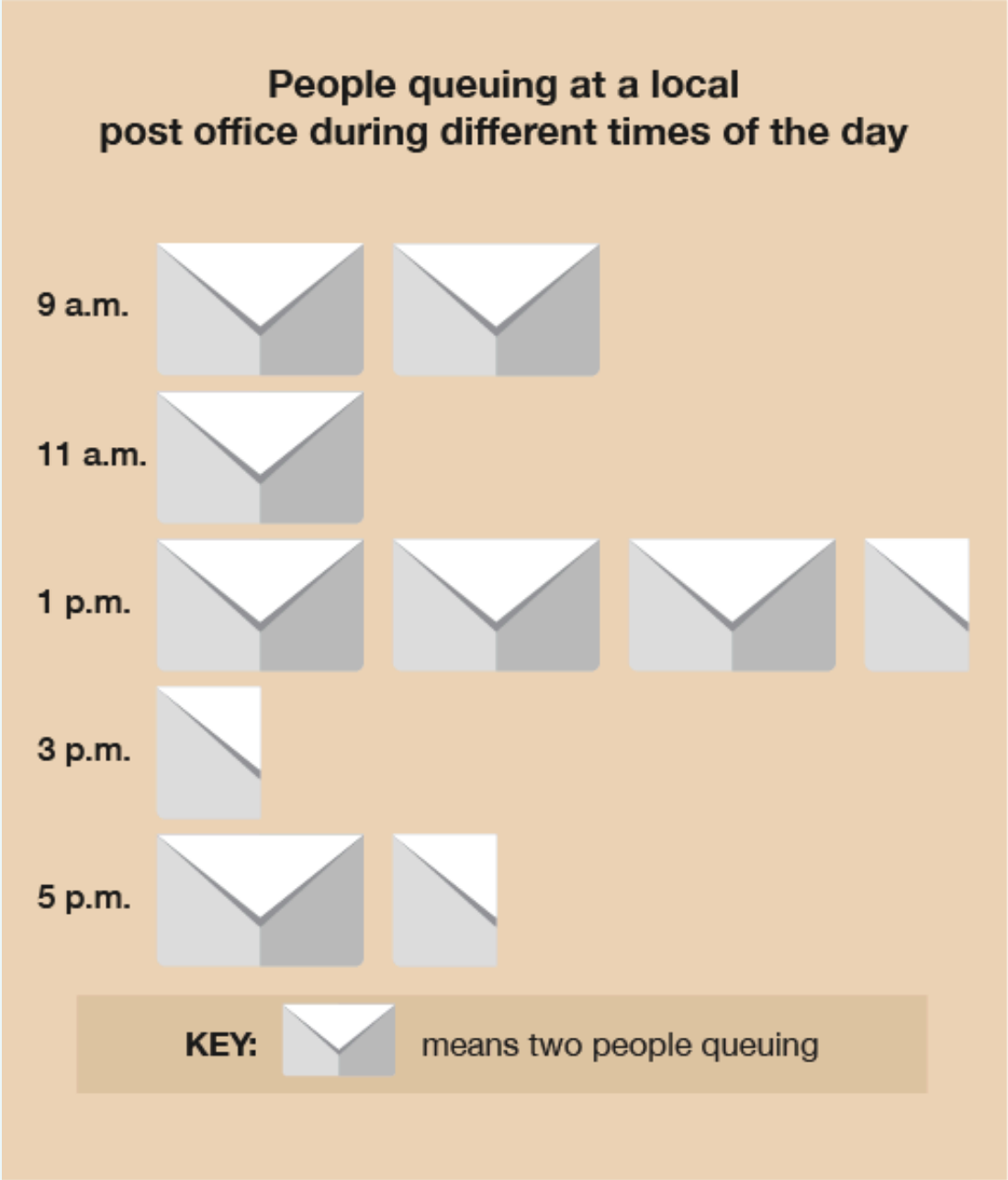


Figure 9 Post office pictogram

Activity 1: Identifying polygons

Summary

In this section you have learned about how to present data in pictograms.

4 Pie charts

Charts are basically maths pictures. There are two types of charts: bar charts, which you'll look at in the next section, and pie charts.

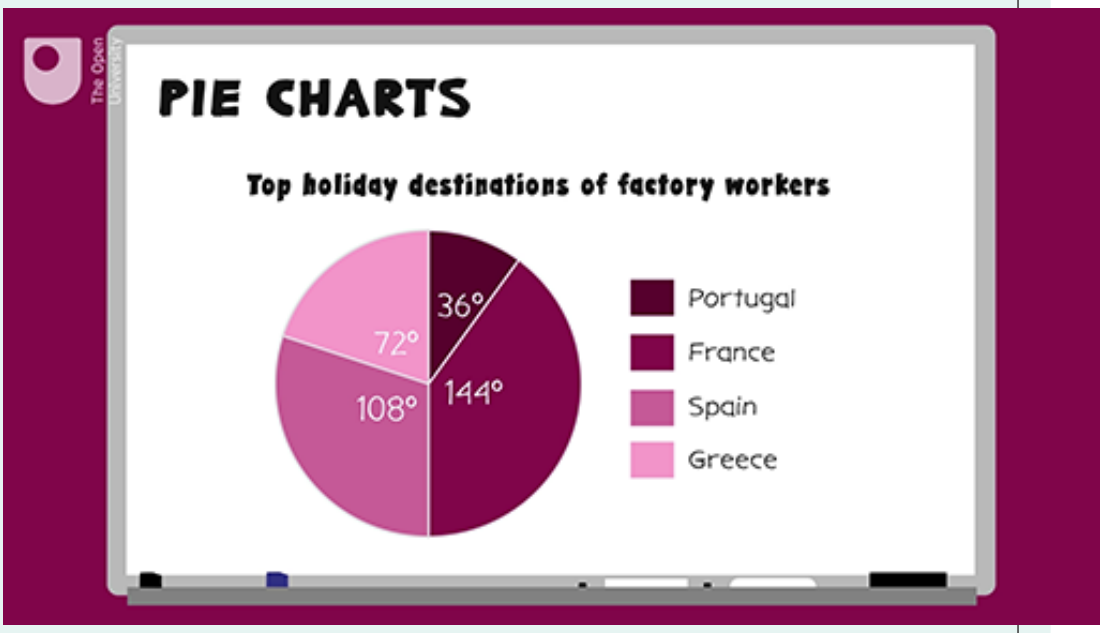
Pie charts are a clear way of presenting data, but they can be difficult to draw and the calculations involved in creating them can be complicated.

A pie chart is a circle (or 'pie') divided in sections (or 'slices'). The sizes of these sections represent the data. Pie charts must contain both a title and a key that explains what each section means.

Example: Soap operas

How would you present information as a pie chart? Watch the following video to find out.

Video content is not available in this format.



Method summary

- Find out what the whole of the 'pie' is going to represent – this is the total of your categories added together.
- Divide 360 (the size of a circle in degrees) by this total to tell you what one unit of your data makes. Use a calculator if you need to!
- Multiply the amount for this one unit by the size of each category.
- This gives the size of what each segment should be (in degrees).
- Draw a circle and draw a line from the middle of the circle to the top.
- Starting from this line, use a protractor to measure and draw each slice.
- Label the slices, or use a key to show what each segment represents.
- Give your pie chart a title.

Now try the following activity. If you get stuck, refer to the method summary above, and remember to check your answers once you have completed the questions.

Activity 10: Creating a pie chart

Calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers once you have completed the questions.

In a survey, 18 people were asked what their favourite pets were. The responses were as follows:

Pet	Number of people
Cat	5
Dog	6
Rabbit	4
Bird	1
Fish	2

Draw a pie chart to represent this information.

Answer

To find out how many degrees each animal is represented by, you must carry out this calculation:

$$360 \div 18 = 20$$

Therefore, each animal is represented by 20°. We can then calculate the size of each section:

Pet	Number of people	Angle
Cat	5	$5 \times 20° = 100°$
Dog	6	$6 \times 20° = 120°$
Rabbit	4	$4 \times 20° = 80°$
Bird	1	$1 \times 20° = 20°$
Fish	2	$2 \times 20° = 40°$

As a check, you can make sure that the degrees for each section add up to 360° in total:

$$100° + 120° + 80° + 20° + 40° = 360°$$

From these measurements you should construct a pie chart as follows:

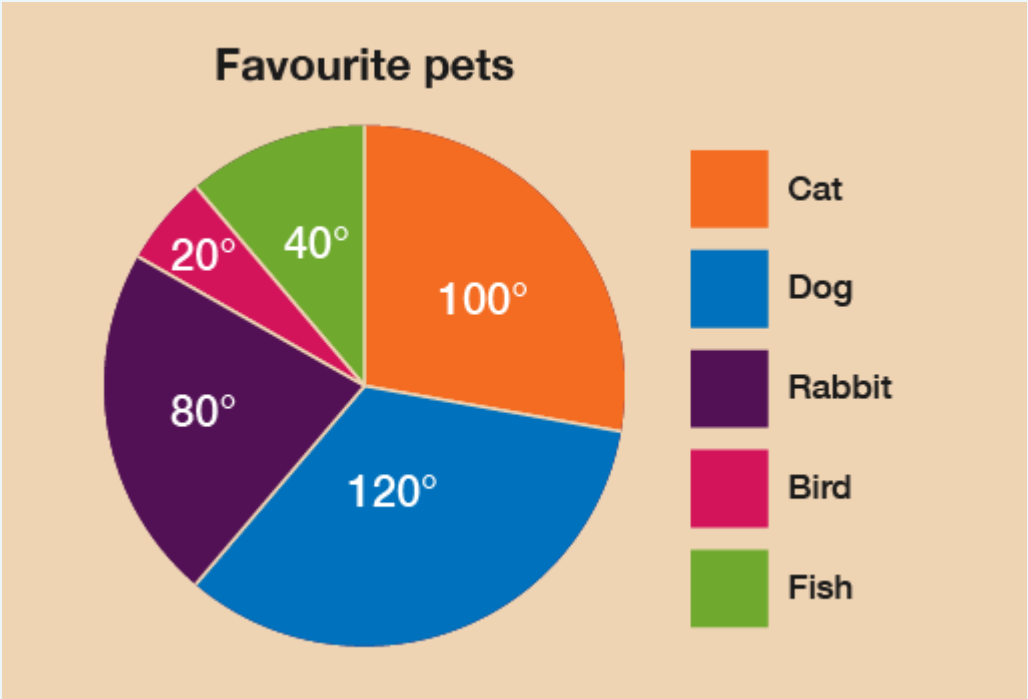


Figure 10 Pets pie chart

Bill records how he spends his time over a typical day. Draw a pie chart to represent this information:

Activity	Time spent
Sleeping	8 hours
College	7 hours
Eating	1 hour
Social media	5 hours
Travelling	2 hours
Gym	1 hour

Answer

The time spent on activities adds up to 24 hours – as you would expect! To find out how many degrees each hour is represented by, you must carry out this calculation:

$$360 \div 24 = 15$$

Therefore, each hour is represented by 15°. We can then calculate the size of each section:

Activity	Time spent	Angle
Sleeping	8 hours	8 × 15 = 120
College	7 hours	7 × 15 = 105
Eating	1 hour	1 × 15 = 15
Social media	5 hours	5 × 15 = 75
Travelling	2 hours	2 × 15 = 30
Gym	1 hour	1 × 15 = 15

You can check these figures by making sure that the degrees for each section add up to 360° in total:

$$120° + 105° + 15° + 75° + 30° + 15 = 360°$$

Using these values you can now draw your pie chart – don't forget to add a title and a key. From these measurements your pie chart should look like this:

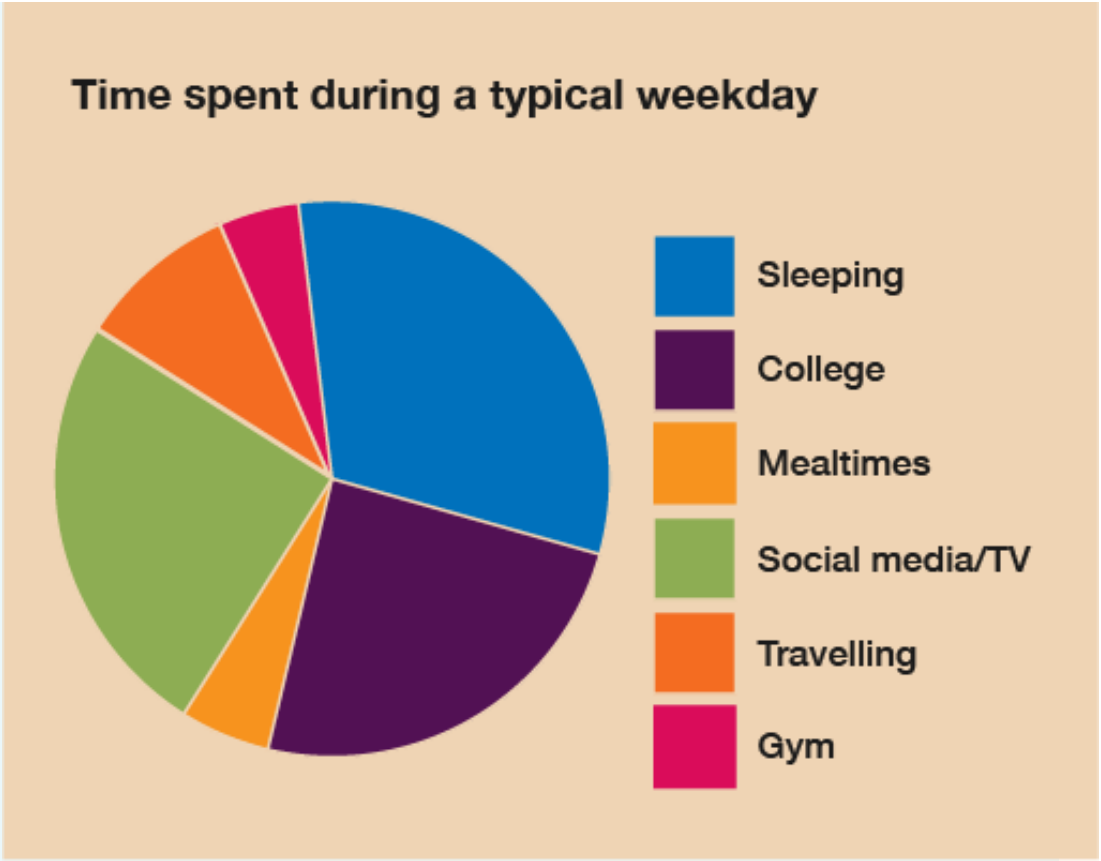


Figure 11 Daytime activities pie chart

A tutor records the test results for a class:

Grade	Number of students
A	10
B	13
C	7
D	4
E	2

Draw a pie chart to show the breakdown of results.

Answer

The total number of students is 36. To find out how many degrees each student is represented by, you must carry out this calculation:

$$360 \div 36 = 10$$

Therefore, each hour is represented by 10°. We can then calculate the size of each section:

Grade	Number of students	Angle
A	10	10 × 10 = 100
B	13	13 × 10 = 130
C	7	7 × 10 = 70
D	4	4 × 10 = 40
E	2	2 × 10 = 20

Using these values you can now draw your pie chart, which should look like this:

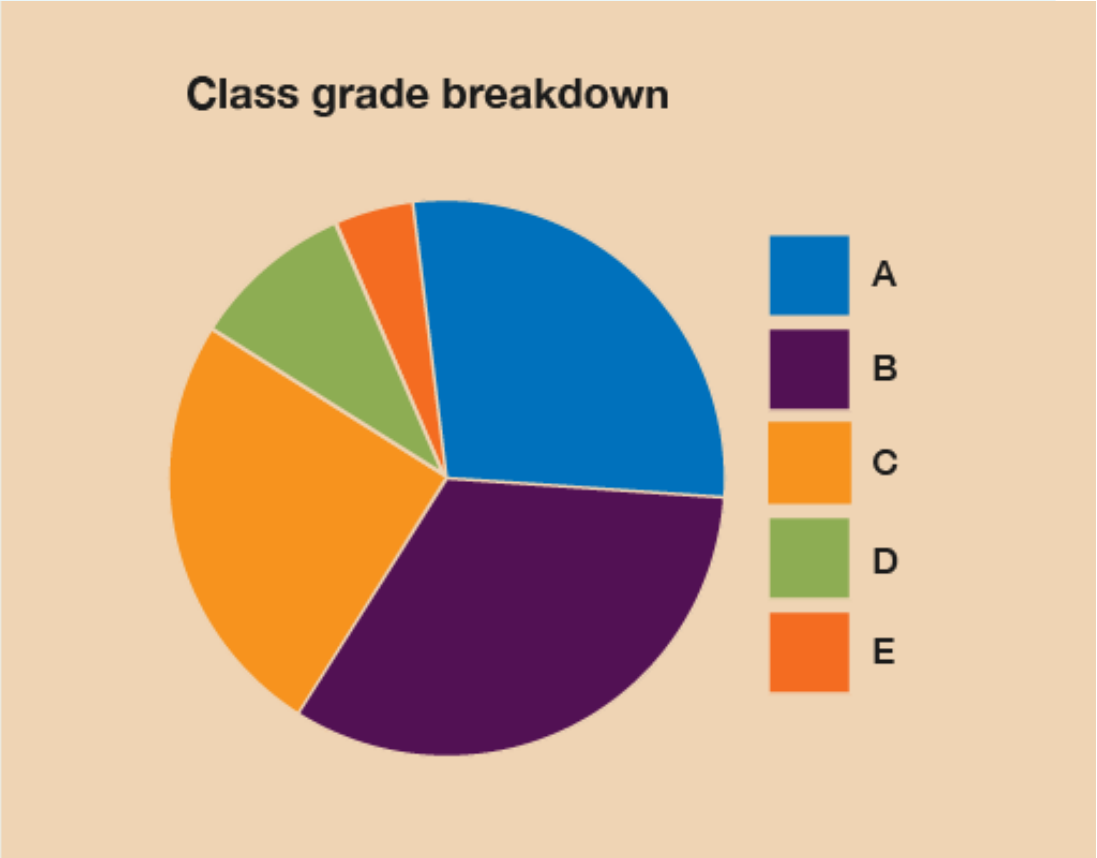


Figure 12 Grade breakdown pie chart

Summary

In this section you have learned about how to present data in pie charts.

5 Bar charts

Another way of presenting information would be in a bar chart.

Bar charts are useful because they show data clearly. They must contain the following information:

- **A title** explaining what the bar chart means.
- **Labels** that tell you what each bar means. This could be a key or just a label underneath the line that runs along the bottom of the bar graph (the **horizontal axis**).
- The line going up the left-hand side of the bar graph (the **vertical axis**) must have numbers at equal intervals (a scale). This tells you how big the bars are so that your reader can read the data.

Example: A traffic survey

Let's have a look at the data from a traffic survey displayed in a table:

Colour of car	Number of cars
Grey	4
Black	3
Red	1
Blue	2
White	1

This data could be presented in a bar chart, as follows:

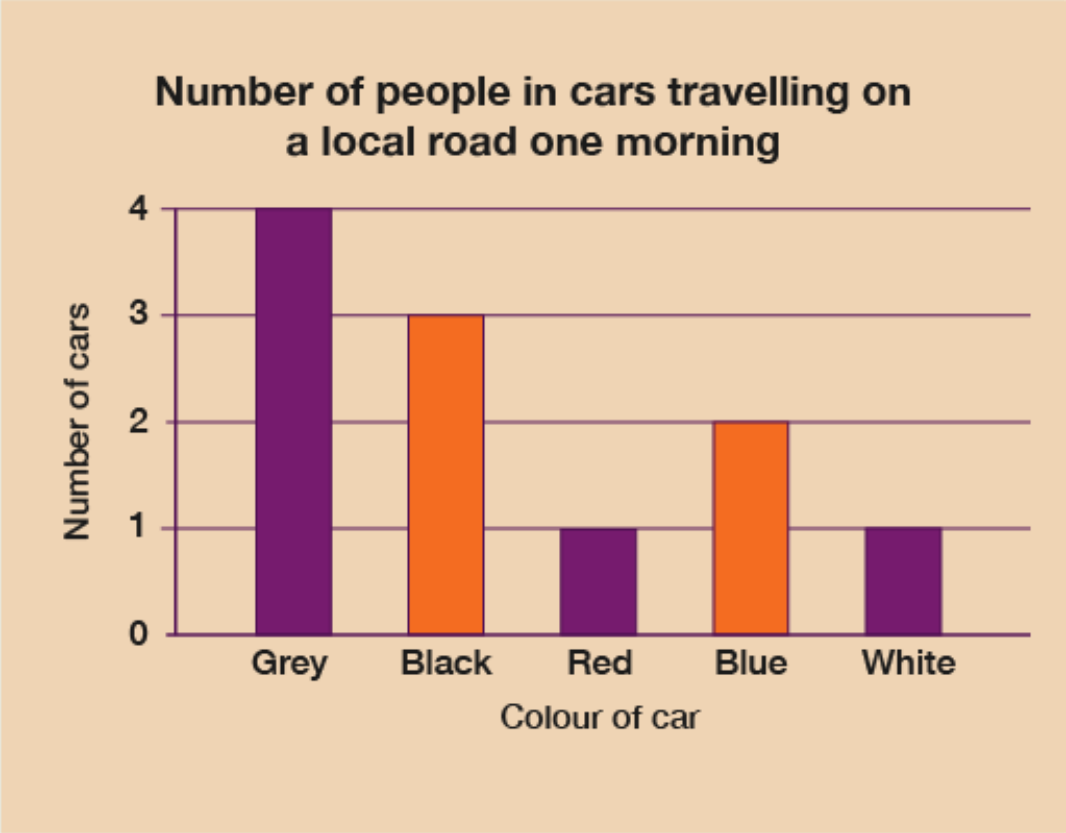


Figure 13 Traffic survey bar chart

Method

Before you start to draw your bar chart, you need to decide what your labels will be and what number intervals you are going to use – that is, how 'tall' your bars are going to be.

To do this you need to look at your data and find the biggest number of occurrences (that is, the largest category). In this traffic survey this is not too difficult: the most cars in one category was 'grey cars', which had four cars.

This means that the highest number on the vertical axis is 4. The numbers in the survey are discrete data – you can't have half a car! – so the numbers on this axis will be 0, 1, 2, 3 and 4. The vertical axis should always start at 0 and go up by the same number each time. We can take the label for this axis from the table: 'Number of cars'.

Hint: Discrete data is data made up of things that are separate and can be counted.

You now need to decide on how many bars you are going to draw. This is already decided for because there are five categories in the survey:

- grey cars
- black cars
- red cars
- blue cars
- white cars.

So there will be five bars along the horizontal axis of the bar chart, which should be labelled 'Colour of car'.

Once you have drawn the axes and labels, you can draw the bars as follows:

- Use a ruler.
- The height of each bar is the number you have for that category.
- The width of the bars must be equal.
- When you have finished drawing your bar chart, don't forget to give it a title.

Method summary

- Find out what the highest number of items is. This will give you the biggest number on the vertical axis (the one on the left-hand side). This will be the size of the tallest bar.
- Decide how many bars to draw: this is the number of categories you are dealing with. The bars should be equal in width.
- Draw and label your axes.
- Use a ruler to draw your bars.
- Make up a title for your bar chart.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 11: Creating a bar chart

The following table shows the number of flights from a regional airport on one day of the week made by different airlines.

Airline	Number of flights
Reilly Air	3
Easyfly	4
English Airways	1

Draw a bar chart to display this data. Remember to label your axis and give your chart a title.

Answer

Check with the following suggestions before continuing;

The most flights on one day is four, so you must ensure that the vertical axis should start at 0 and go up to 4.

You must label the horizontal axis with the names of the airlines and the vertical axis with the number of flights.

The title must clearly state what data the bar chart is showing.

Your graph should look something like the following:

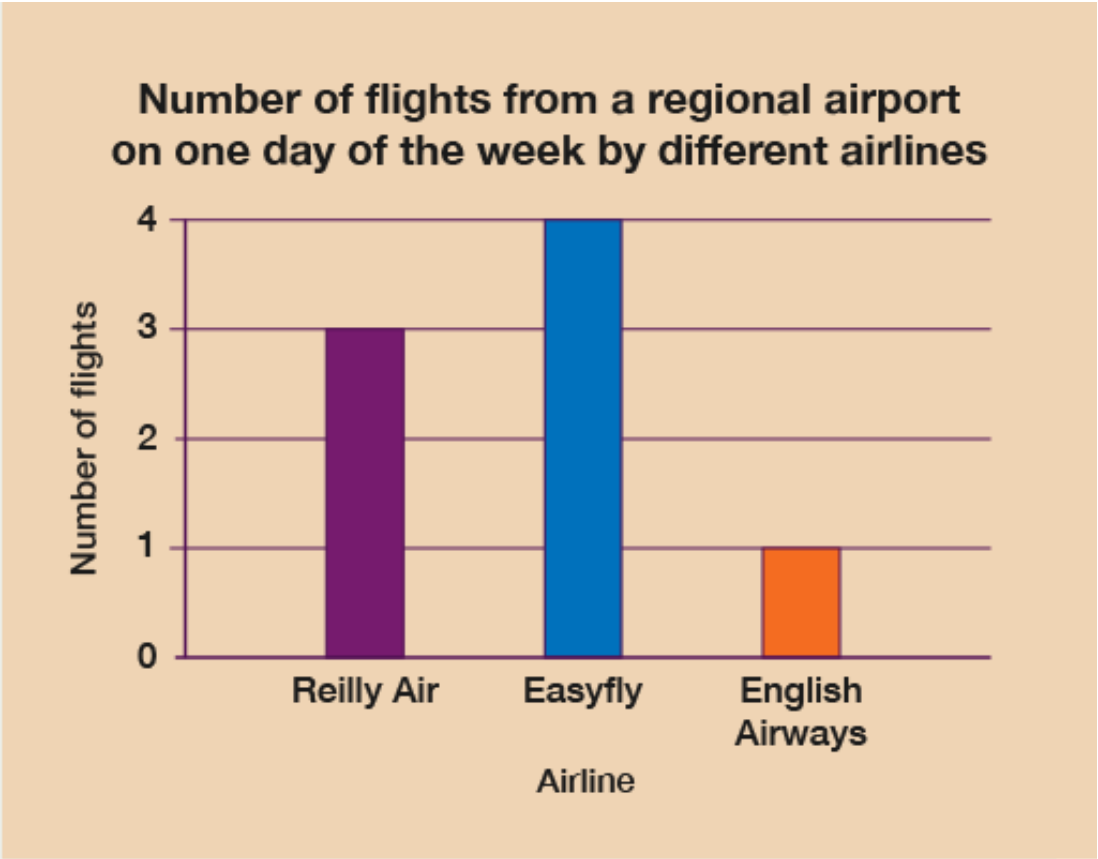


Figure 14 Flights bar chart

With larger numbers, your scale may not go up by one. You may have your scale going up by two, five or ten, etc., depending on the numbers you are working with. The main thing to remember is that the scale has to go up in equal intervals.

Activity 12: Creating another bar chart

The following table shows the number of different sandwiches sold by a local café in one week:

Sandwich type	Number of sandiwches sold
Cheese	35
Tuna	18
Egg	24
Chicken	40
Bacon	38

Draw a bar chart to represent this data. Don't forget to label your axis and give your chart a title, and make sure you use a suitable scale.

Answer

The most sandwiches sold is 40, so you should ensure that the vertical axis should start at 0 and go up to 40. This is quite a high number, so your scale may go up in increments of five or even ten.

You must add the names of the sandwich fillings to the horizontal axis and give the axes suitable labels – for example, 'Sandwich fillings' for the horizontal axis and 'Number of sandwiches sold' for the vertical axis.

The title must clearly state what data the bar chart is showing.

Your bar chart should look something like this:

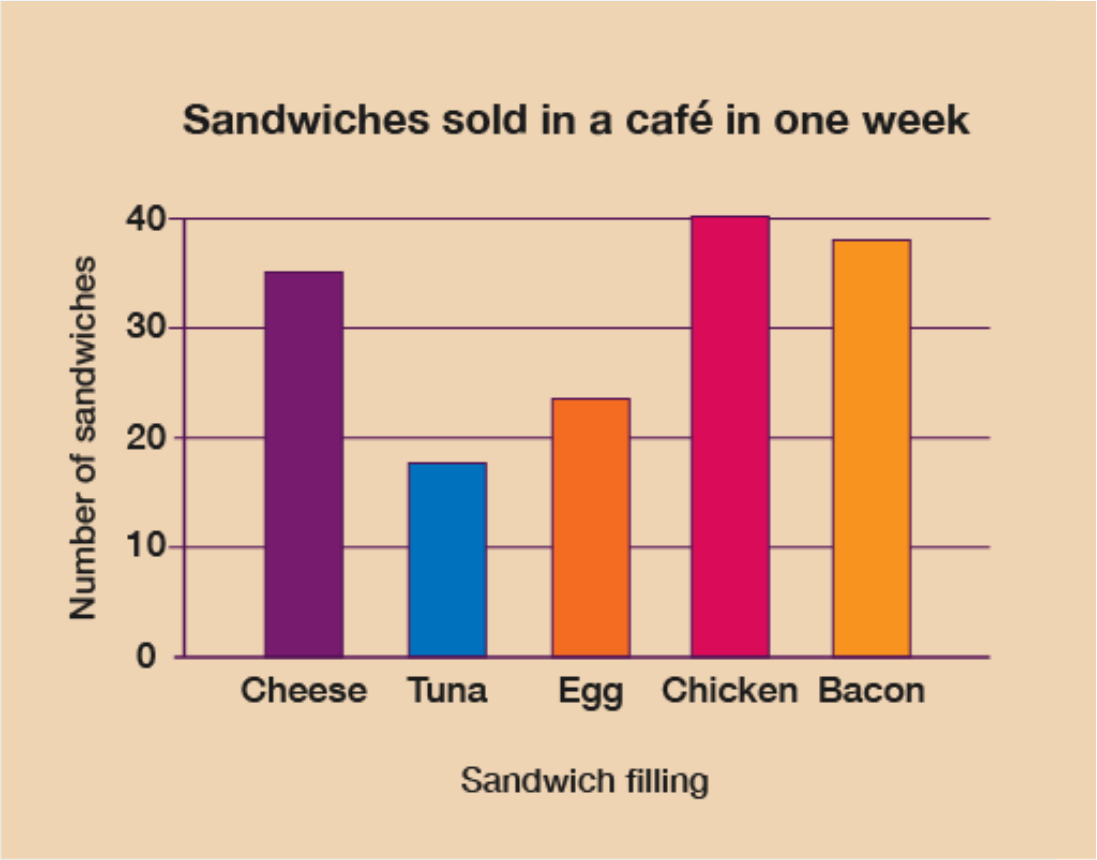


Figure 15 Sandwiches sold bar chart

Graphs can easily be created on a computer. There are videos on YouTube that can help you to learn how to do this.

Summary

In this section you have learned about how to present data in bar charts.

6 Line graphs

Now that you've had a look at pie charts and bar charts, let's take a look at line graphs. These are drawn by marking (or plotting) points and then joining them with a straight line. You might have seen them used in holiday brochures or maybe on the television.

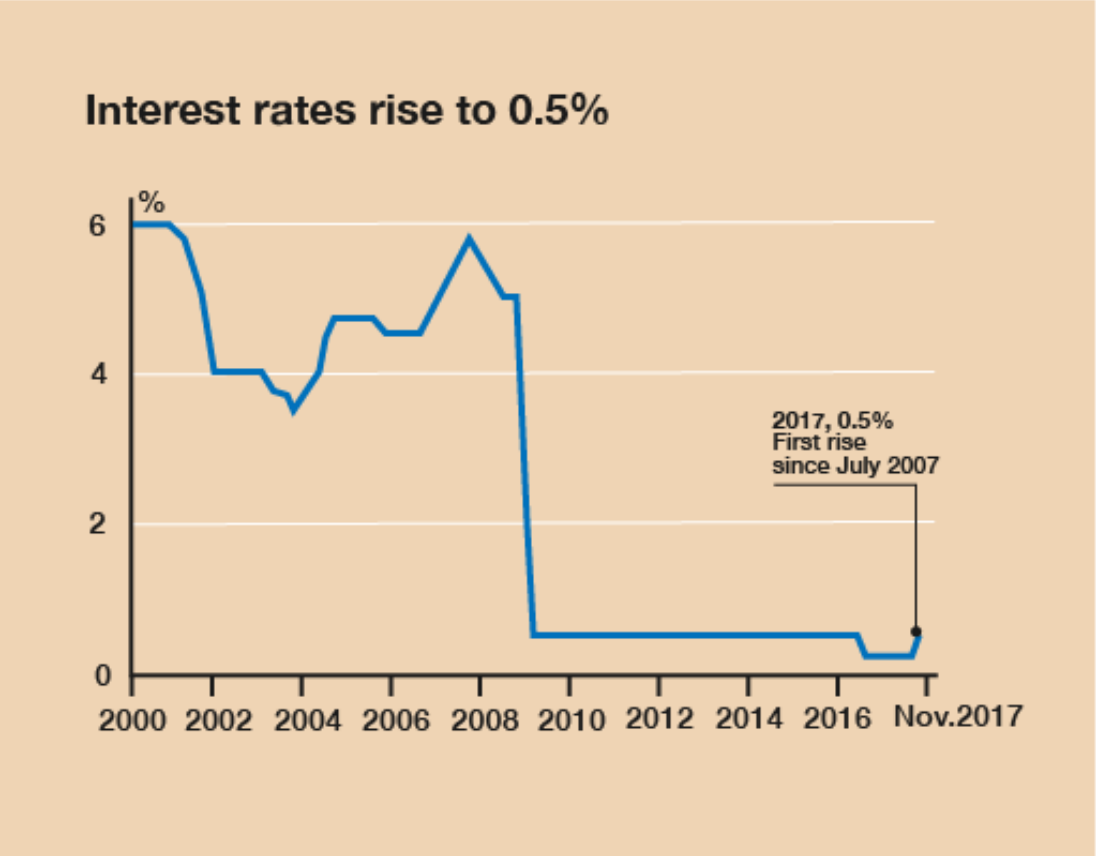


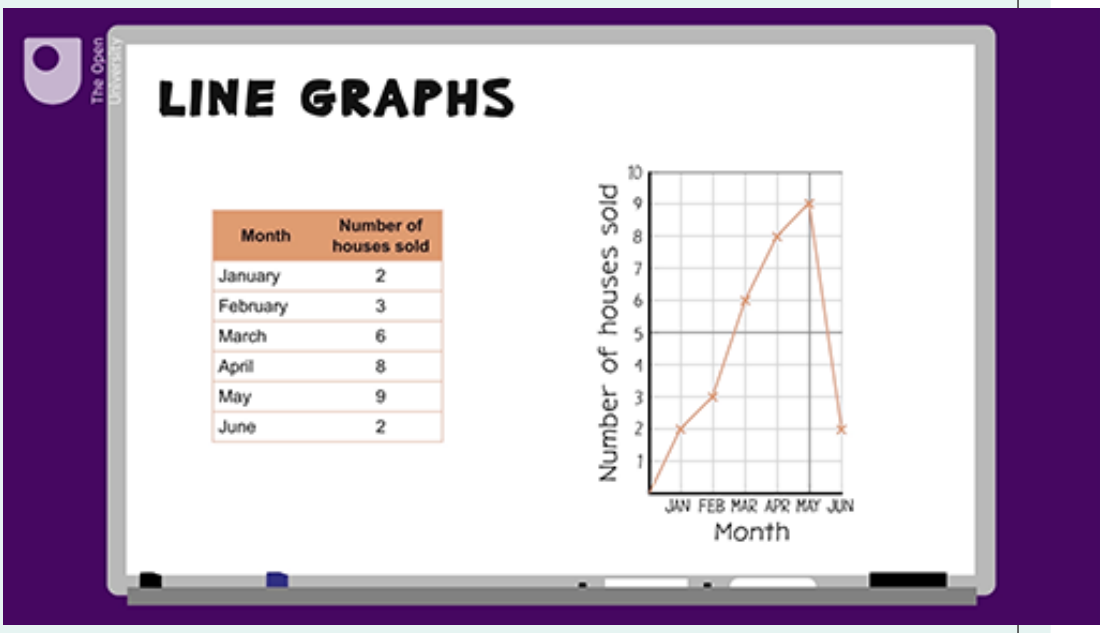
Figure 16 Interest rates line graph

Hint: It is best to use graph or squared paper when drawing line graphs because it makes it easier to plot the points.

Example: The estate agent

How would you present information as a line graph? Watch the following video to find out.

Video content is not available in this format.



Method summary

To draw a line graph you need to:

- draw the horizontal and vertical axes, and label them
- divide these axes into suitable scales – to do this, you need to look at the data and find out what the smallest and largest numbers are
- plot the points from your data, using a pencil to make small crosses
- join the points using a ruler
- give your graph a title.

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 13: Creating a line graph

Line graphs are often used in holiday brochures to show temperatures or hours of sunshine at a particular resort.

The following table shows the hours of sunshine at a holiday resort. Draw a line graph using the data from the table and then answer the questions below.

Month	Hours of sunshine
May	6
June	7
July	8

August	9
September	8
October	7

1. Which month was the sunniest?
2. Which month had the least sunshine?

Answer

When drawing your line graph you should:

- draw the horizontal axis, labelling it ‘Months’, and the vertical axis, labelling it ‘Hours of sunshine’
- divide these axes into suitable scales – your smallest and largest numbers are 6 and 9, so your scale could be one square for one hour
- plot the points from your data, using a pencil and make small crosses
- join the points using a ruler
- give your graph a title such as ‘Hours of sunshine at a holiday resort over a six-month period’.

The finished line graph should look something like this:

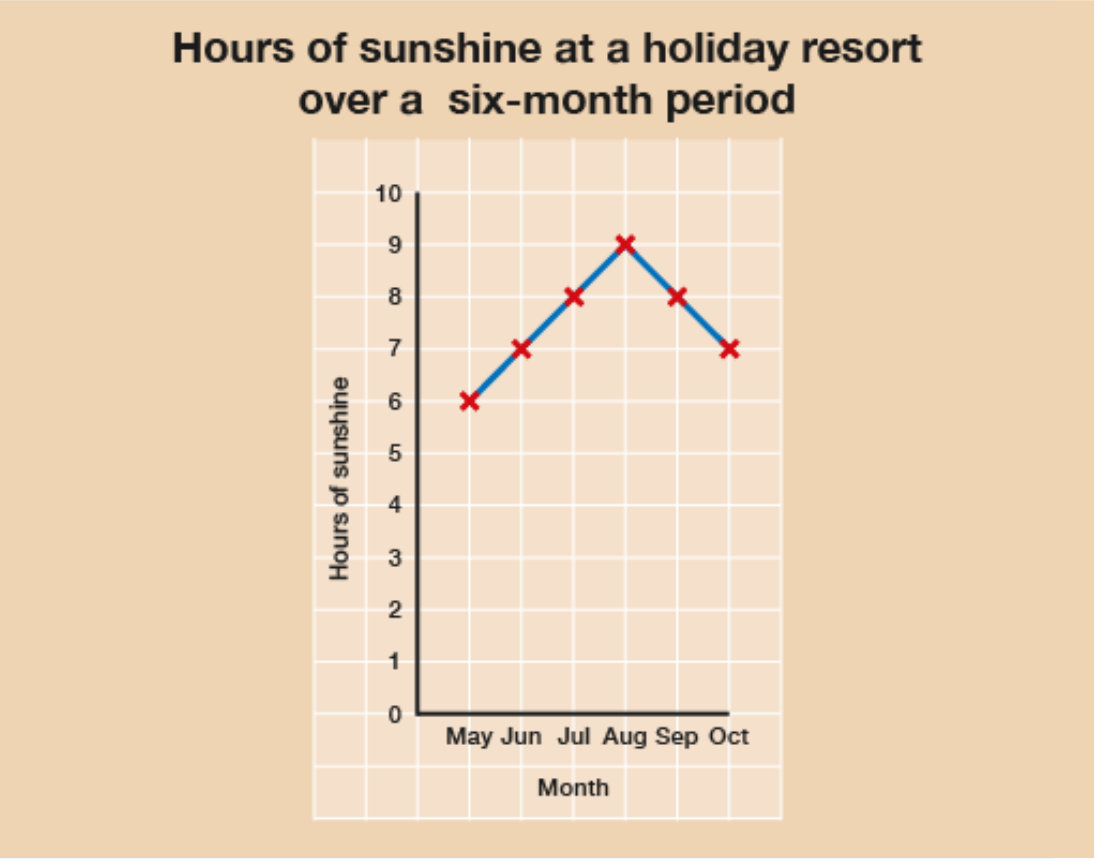


Figure 17 Sunshine line graph

In answer to the questions:

1. August is the sunniest month.
2. May is the least sunniest month.

Look at the following line graph. Sometimes it makes sense to create a graph in landscape rather than portrait.

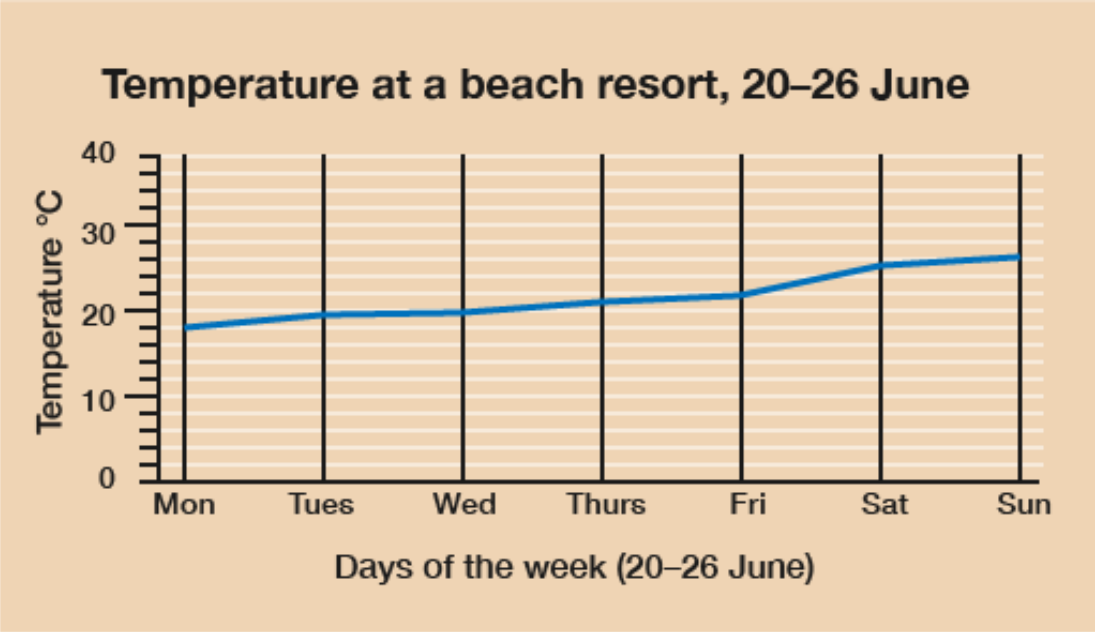


Figure 18 Temperatures line graph

Summary

In this section you have learned about how to present data in line graphs.

7 Choosing the best way to present your data

You have looked at several ways of presenting data, but how do you select the best one to use?

- **Tables** can be used to organise complicated data. They are useful if you need to look up information.
- **Pictograms** are a good way of displaying data in an accessible, 'fun' way. They are good at showing simple data. However, a picture key can make it difficult to be accurate when the key is used to represent larger values: if the following figure represents 50 ...

- **Pie charts** show the breakdown of different parts of a whole data set. Each segment represents a percentage or proportion of the whole amount. Pie charts are good for showing which parts take up the largest or smallest part of the pie. They are not so good when there isn't much difference between the values, as it can be difficult to see small variations.
- **Bar charts** are great for comparing discrete data.
- **Line graphs** are often used to show changes or trends in data over time.

Activity 14: Choosing how to display data

Select the best way to display the following sets of data:

1. The number of visitors to an exhibition over a day.
2. The breakdown of each food group that makes up a healthy diet.
3. The profit made by different branches of a shop over three months.
4. The number of patients who missed GP appointments over six months in a GP surgery waiting room.

Answer

1. A line graph would be suitable because it would show the change in visitor numbers over the day.

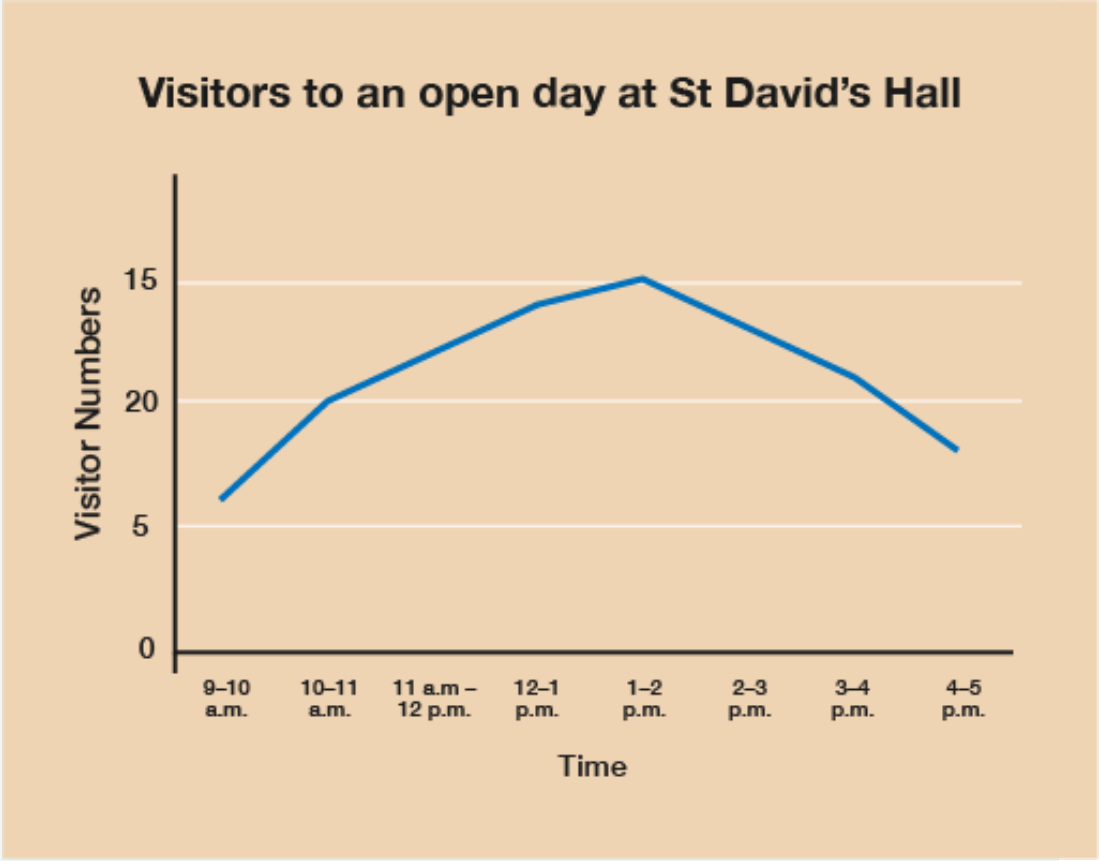


Figure 19 St David's Hall line graph

2. A pie chart would show the proportion of each food group compared to the others.

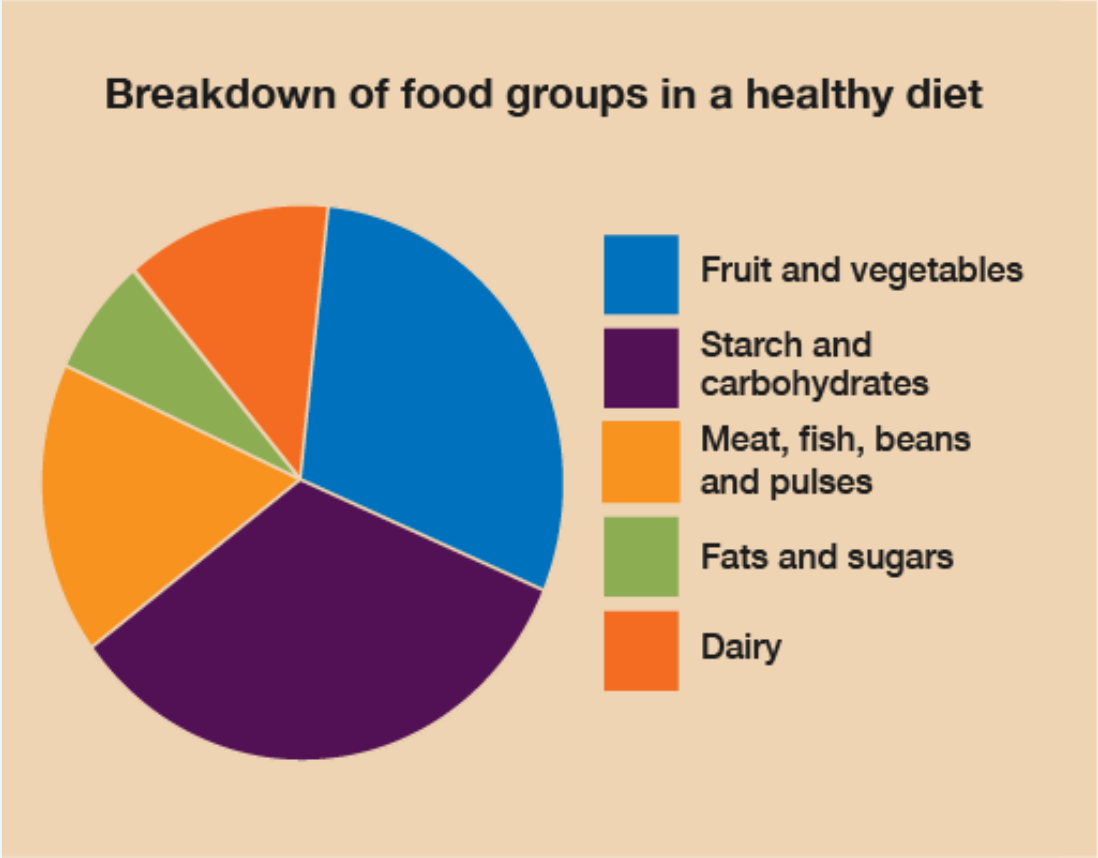


Figure 20 Healthy diet pie chart

3. A bar chart would allow comparison of profits at the different branches.

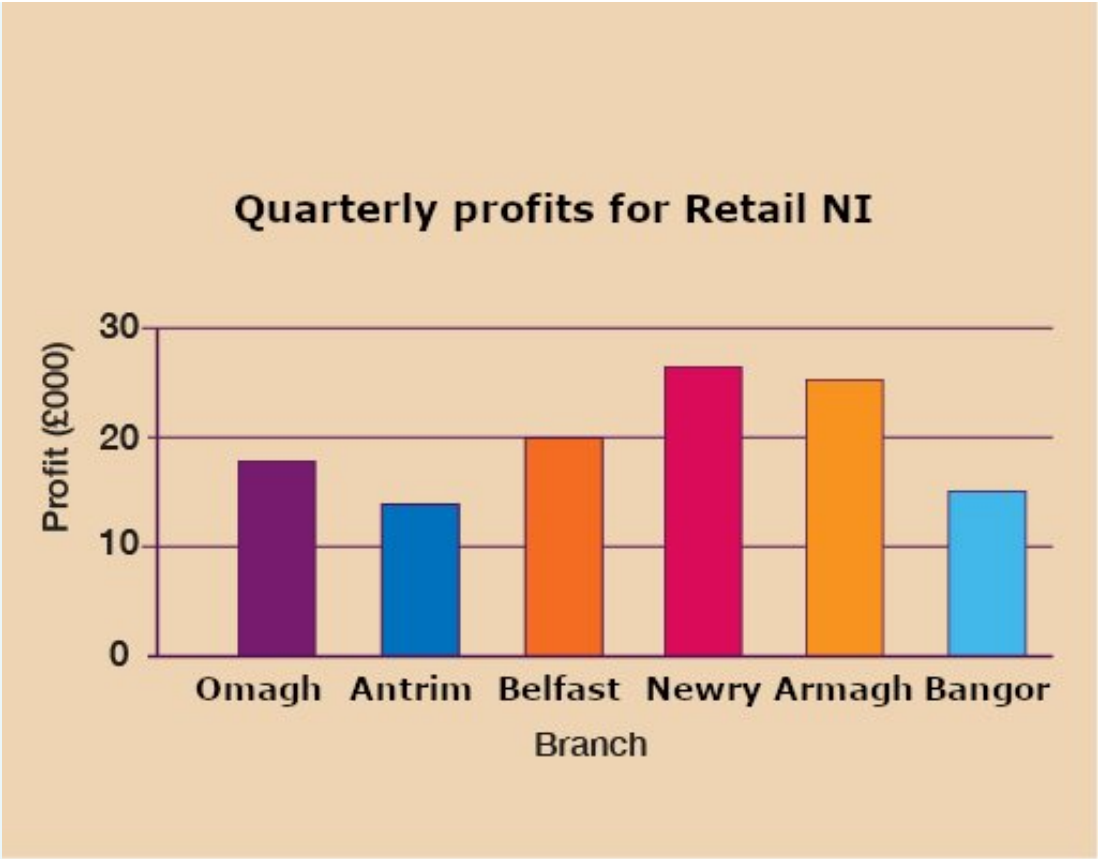


Figure 21 Retail NI bar chart

4. A pictogram would make the results accessible and easy to read.

Figure 22 Missed appointments pictogram

Self-check: always remember the following statements

Before moving on, you need to make sure you are able to collect, organise and show data in the forms of tables, diagrams, charts and graphs. Ask yourself the following questions:

- When I draw tables, diagrams, charts and graphs, is my data displayed clearly so that the information is easy to understand?
- Do I always include titles, scales, labels and keys when they are needed?
- Have I chosen the most appropriate way of presenting my data?

If you are not sure about these points, show your work to someone else and ask if they understand the data.

8 Averages

An average is a middle, or ‘typical’, value. Sometimes it’s easier to present data numerically rather than graphically, and to find one number to represent a collection of data instead of lots of numbers. You can do this by finding the arithmetical average: ‘arithmetical’ means ‘doing sums’, and the ‘average’ is the representative value of all our data. So working out the arithmetical average means working out a representative value for your data with mathematical calculations. The arithmetical average is better known as the mean average. There are other types of average, but we will focus on the mean here.

Note: With data we talk about ‘data sets’, or sets of data. ‘Sets’ is just another word for ‘group’. So if we carried out a survey, we would have a data set.

You’ll be familiar with the word ‘average’. Outside maths, it is used to mean ‘not special’ or ‘just OK’. But in maths, ‘average’ means we can have one typical value that is representative of all our data and that uses all our data.

Where do we find averages in real life?

- If you look at a holiday brochure you will see that it will talk about the ‘average’ hours of sunshine in a day.
- A teacher might work out the average marks for students in a class.
- When you go on a journey you might talk about our average speed.
- The average goals scored per game over a season by your football team.

Example: Mean test scores

The arithmetical, or mean, average is not difficult to work out.

Look at the following example based on the first example in the list above:

Student	Score
Sara	11
Ceri	13
Sian	14
Dylan	15
Aled	17
Ewan	17
Paul	15
Elisa	20
Bea	20
Gwyn	18

In order to calculate the mean average, you need to do the following:

1. Add up all of your data to a total (let's call this total 'A').
   In this example the data is the students' test scores, so we need to add:
   11 + 13 + 14 + 15 + 17 + 17 + 15 + 20 + 20 + 18 = 160
2. Add up the number of categories that your data falls into. This would be the number of students (let's call this amount 'B'). In this case there are 10 students.
3. To calculate the mean average you divide the total of your data (A) by the number of bits of data (B). So:
   A ÷ B = the average
   In the example above the scores added to a total of 160, divided by 10 (the number of students):
   160 ÷ 10 = 16
   So the mean average score would be 16.

Have a look at the example below, where you will be looking at the mean average hours of sunshine.

Example: Mean average hours of sunshine

The hours of sunshine per day during one week's holiday to Barmouth in June was recorded as follows:

Day	Hours of sunshine
Sunday	6
Monday	1
Tuesday	7
Wednesday	8
Thursday	5
Friday	2
Saturday	6

You could draw a bar chart or a line graph to present this data. However – as you might expect from the British weather – the amount of sunshine varied a lot from day to day.

It might be more useful to find out the mean average amount of sunshine per day. This would give you one value, which you could use as a guide as to how much sunshine to expect per day.

Method

To work out this mean value you need to:

- add up the amount of sunshine for each day
- divide this by the number of days you have the data for.

With this example we have:

6 + 1 + 7 + 8 + 5 + 2 + 6 = 35 hours of sunshine for the week

and seven days of data. So, the mean is:

35 ÷ 7 = 5 hours

Note: You must remember what units you are working in and write in these units after your average value – otherwise, it won't make sense.

So from this data you can see that, on average, there were five hours of sunshine per day in a week in June in Barmouth. You could then use that information to help choose your next holiday: if you wanted more than five hours of sunshine a day for a holiday in June, you would choose somewhere hotter (like Spain, perhaps).

Method summary

- Add up all of your data.
- Find out the number of categories that your data falls into (how many bits of data you have).
- Divide the total of your data by the number of categories of data to give the mean average.
- Don't forget to put what units you are working in, for example hours, goals, people, etc.

Now try the following activity. Remember to refer to the example if you get stuck and to check your answers once you have completed the questions.

Activity 15: Finding the mean average

Calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers once you have completed the questions.

1. The ages of four children in a family are 4, 6, 8 and 10 years. What is the mean average age?
2. Find the average of the following data sets:
   a. 4, 6, 11
   b. 3, 7, 8, 4, 8
   c. 8, 9, 10, 9, 4, 2
   d. 11, 12, 13, 14, 15, 16
3. The number of goals scored by a football team in recent matches were as follows:

2	3	0	1	3
2	3	2	1	3

Work out the mean number of goals per match.

Hint: Notice how it is important to include the zero in the calculations.

Answer

Check your answers with the answers below.

1. First, add all of the ages together:
   4 + 6 + 8 + 10 = 28
   Then divide this total by the amount of data given:
   28 ÷ 4 = 7
   The average age is 7.
2. You will find the following answers using the same calculation you used for question 1:
   a. Add all the numbers (4 + 6 + 11 = 21) and then divide this answer by the amount of data given (21 ÷ 3 = 7). The answer is 7.
   b. Add all the numbers (3 + 7 + 8 + 4 + 8 = 30) and then divide this answer by the amount of data given (30 ÷ 5 = 6). The answer is 6.
   c. Add all the numbers (8 + 9 + 10 + 9 + 4 + 2 = 42) and then divide this answer by the amount of data given (42 ÷ 6 = 7). The answer is 7.
   d. Add all the numbers (11 + 12 + 13 + 14 + 15 + 16 = 81) and then divide this answer by the amount of data given (81 ÷ 6 = 13.5). The answer is 13.5. Note that the mean average may not be a whole number.
3. The average number of goals per match is 2:
   2 + 3 + 0 + 1 + 3 + 2 + 3 + 2 + 1 + 3 = 20
   20 ÷ 10 = 2

Now have a go at another activity to check your knowledge.

Activity 16: The maths test

As before, calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers once you have completed the questions.

1. In a maths class the scores for a test (out of 10) were as follows:

5	6	6	4	4
7	3	5	6	7
8	6	2	8	5
4	5	6	5	6

What is the mean score?

2. Some of the students felt that the teacher had been too harsh with their marks. The tests were remarked and the new results were as follows:

4	6	6	4	4
6	1	5	6	6
7	6	1	9	5
3	5	6	5	5

Work out the mean score for these new results. Which set of results gave the best marks? Was the teacher harsh with the first marking?

Answer

1. First, add up the total number of marks:

   $5 + 6 + 6 + 4 + 4 + 7 + 3 + 5 + 6 + 7 + 8 + 6 + 2 + 8 + 5 + 4 + 5 + 6 + 5 + 6 = 108$

   Then divide this by the number of scores (or the number of students), which is 20:

   $108 \div 20 = 5.4$

   So the average score is 5.4 out of 10.
2. Again, first add up the total number of marks:

   $4 + 6 + 6 + 4 + 4 + 6 + 1 + 5 + 6 + 6 + 7 + 6 + 1 + 9 + 5 + 3 + 5 + 6 + 5 + 5 = 100$

   Then divide this total by 20:

   $100 \div 20 = 5$

   The best set of results was the first set. The teacher had not been marking it harshly.

What are the advantages and disadvantages of using the mean average?

Ever heard of families with 2.4 children? This is the national average but it means nothing – because you can't have 0.4 of a child! This highlights one of the problems with averages: the value you get may not be a real value in terms of what you are talking about.

Another problem is that the mean value will be affected by values that are much higher or much lower than the others in the data set. For example, your football team could be having a really bad season, scoring nothing in nine games. The mean number of goals scored per game in these nine games would be zero (total goals = 0 and matches played = 9, so the mean would be $0 \div 9 = 0$). Then, suddenly, they start to play very well and in the next match score ten goals. This would increase the mean average goals scored to one goal per match (total goals = 10 and matches played = 10, so the mean would be $10 \div 10 = 1$), which would make it look as though they'd scored a goal in every match when they hadn't.

The mean is a good way of calculating the average, however, because it isn't too complicated to work out (compared to some other statistical calculations) and it uses all the available data.

Summary

In this section you have:

- learned that the mean is one sort of average
- learned that the mean is worked out by adding up the items and dividing by the number of items
- understood that the mean can give a 'distorted average' if one or two values are much higher or lower than the other values.

9 Finding the range

We talk about ‘range’ in real life in the following situations:

- Schools will have a range of ages of children.
- Companies will have employees on a range of salaries.
- Supermarkets have goods at a range of prices.

The first thing to do when finding ranges is to find the lowest and highest values in your data set. The range is one number that tells you the difference between the highest and lowest values.

To help you work out the range:

- If your data set is not too big then the best thing to do is put the values in numerical order (lowest first).
- As you go through the data set, tick or cross off the numbers as you put them in order so that you don’t count the same one twice or miss one out altogether:

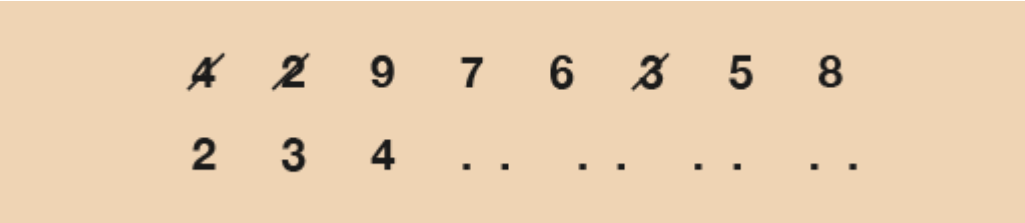


Figure 23 An example of a data set

Once you have the highest and lowest values, you then have to take the lowest away from the highest. This will give you the range.

The range measures the spread of a set of data. It is important because it can tell you how diverse your data is (or isn’t).

Take, for example, the ages of members of a gardening club. If the average age is 40 years old, say, then this doesn’t tell you much about the people in the club.

- If the spread of the ages was ten years, then you know that every member is in either their thirties or forties.
- But if the spread was 70 years, then both teenagers and pensioners belong to the club.

So the range gives you more information about a data set.

Remember that when you work out the range, you still have to include the units you are working in. So if you are dealing with ages you will usually be talking about years, so your range will be in years.

Example: Age range

Barry has four children. Sophie is 7 years old, Karen is 4, Max is 12 years and Jason is 10.

What is the range?

Method

The data set is:

7 4 12 10

Let's put these numbers in order first:

4 7 10 12

Doing this makes it is easy to see that the lowest number is 4 and the highest is 12.

The range is worked out by taking the lowest value away from the highest:

Range = 12 – 4 = 8 years

(Don't forget to include the units, in this case years.)

Method summary

- Write the numbers in numerical order (lowest first).
- Find the lowest and highest numbers.
- Take the lowest number away from the highest number to find the range for your data.
- Don't forget to put what units you are working in (e.g. hours, goals, people, etc.).

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 17: Finding ranges

Calculate the answers to the following problems without using a calculator. You may double-check your answers with a calculator if you need to. Remember to check your answers once you have completed the questions.

1. Find the ranges for the following data sets:
   a. 1, 6, 7, 10
   b. 7, 6, 2, 8, 10, 3, 11
   c. 5, 4, 2, 8, 9, 11, 4, 12, 7
   d. 5, 15, 6, 9, 12, 4, 2, 8, 1, 14
2. In a random survey in Newry the ages of 20 people are as follows:

61	18	42	37	32
15	25	52	74	23
49	41	58	31	42
21	27	65	47	35

   a. Write the data set in order with the lowest number first.
   b. What is the lowest age?
   c. What is the highest age?
   d. What is the range?

3. What is the range in temperatures in the following table?

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Weather							
Temperature (°C)	21	20	17	19	24	27	18
Precipitation (%)	15	25	40	70	20	5	86

Answer

Now check your answers:

1. The ranges are as follows:
   a. 10 – 1 = 9
   b. 11 – 2 = 9
   c. 12 – 2 = 10
   d. 15 – 1 = 14
2. The answers are as follows:
   a. Here's the data set in order, with the lowest number first:

15	18	21	23	25
27	31	32	35	37
41	42	42	47	49
52	58	61	65	74

   b. The lowest age is 15 years.
   c. The highest age is 74 years.
   d. The range is 74 – 15 = 59 years. If you wrote '15 to 74', it's the wrong answer. The range is one number. You need to work out the difference.
3. The highest temperature is 27°C and the lowest temperature is 17°C, so the range in temperature is 10°C.

Summary

In this section you have:

- learned that the range measures the spread of a set of data

- understood that the range is the difference between the smallest and largest values in a set of data.

10 Probability

Probability is measuring how likely it is that something will happen. We use probability in different ways in real life:

- Bookmakers use a form of probability to give betting odds on anything.
- Insurance companies use probability to decide how much to charge for all the different types of insurance there is.
- Government departments use probability and statistics to help them govern the country.

(Another word for probability is chance. You might say, 'What are the chances of this happening?')

Working through this section will enable you to:

- understand the possibility of different events happening
- show that some events are more likely to occur than others
- understand and use probability scales
- show the probability of events happening using fractions, decimals and percentages.

Probability is measuring how likely it is that something will happen. Look at the word itself: 'probability'. Can you see it is related to the word 'probable'?

We know that life is full of choices and chances, or that some things are more likely to happen than others.

For example, you could say, 'I might cut the grass tomorrow.' Probability would be used to measure how likely it is that you will cut the grass. There are two options involved here: either you cut the grass or you don't.

If you knew that it was going to rain tomorrow and you had lots of other things to do (and you hate cutting grass), then the probability of actually cutting the grass would be low or even zero! But on the other hand, if you really intended to cut the grass and the weather forecast was good then the probability of cutting the grass would be high.

We use probability to give us an idea of how likely it is that something will happen. It gives us a measuring system.

- If something is very likely to happen, the probability is high.
- If something is not very likely to happen, the probability is low.
- If something has an evenchance we can also say there is a fifty-fifty chance i.e. rolling an even number of a die.

Example: What are the chances?

What's the probability of:

- you winning the lottery this week?
- getting wet in the rain?
- summer following spring?

There's a very low probability that you'll win the lottery this week, and a high probability of getting wet in the rain and summer following spring.

Of course, some things have even chances of happening. For example, if you toss a coin, there is an equal probability of it being heads or tails. This could also be called an even chance, or a fifty-fifty chance, of the coin being heads or tails.

How many different things that have different chances of happening can you think of?

Now try the following activity. Remember to check your answers once you have completed the questions.

Activity 18: Probability of events happening

How many different things that have different chances of happening can you think of? Think of some examples and then check your ideas against the suggested answers.

If you get stuck for ideas, your examples could include:

- the Moon rising tonight
- tossing a coin and getting heads
- a traffic jam at some point this year on the M2
- being kidnapped by aliens
- winning the lottery
- a baby being born a boy.

Obviously there are many other examples.

Looking at the events you thought of, what is the chance of each event happening? Place your event in the correct column in the table.

Events with a high probability of happening	Events with an even chance of happening	Events with a low probability of happening
Provide your answer...	*Provide your answer...*	*Provide your answer...*
Provide your answer...	*Provide your answer...*	*Provide your answer...*

Answer

There is no single correct answer to this activity. Have a look at our suggestions below:

Events with a high probability of happening	Events with an even chance of happening	Events with a low probability of happening
The Moon rising tonight	Tossing a coin and getting heads	Winning the lottery
A traffic jam at some point this year on the M2	A baby being born a boy	Being kidnapped by aliens

10.1 Probability scales

In real life, things usually fall somewhere in between the two extremes of 'will never happen' and 'will definitely happen'. However, some events are certain, while others are impossible: so for example, if you throw a standard dice, you're certain to roll a number between 1 and 6, but it would be impossible to roll a 7.

We can use a probability scale to measure how likely events are to occur:

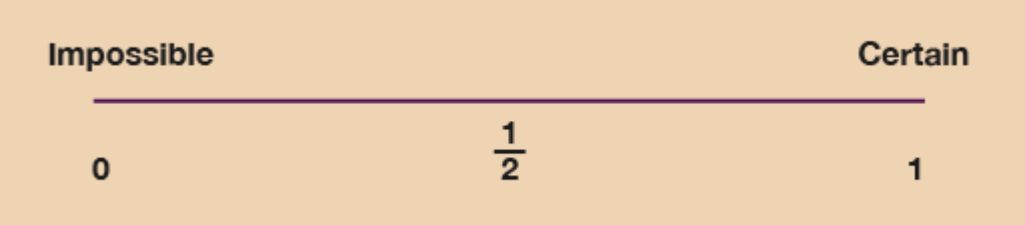


Figure 24 A probability scale

- The probability of an impossible event ('will never happen') is 0.
- The probability of a certain event ('will definitely happen') is 1.
- All other events come between 0 and 1.
- Events with an even chance have a probability of one divided by two: $\frac{1}{2}$, 50% or 0.5.

Now try the following activity, where you'll need a ruler and a pencil. Remember to check your answers once you have completed the questions.

Activity 19: Looking at probability

Use a ruler to draw your own probability scale. Mark on it '0', '$\frac{1}{2}$' and '1'. Label 0 as 'impossible' and 1 as 'certain'.

Then mark these statements on the probability scale with crosses and label them with their question letter:

a. The probability that the sun will rise tomorrow.
b. The probability that you will run the London Marathon next year.
c. The probability of dying one day.

Answer

Here are the suggested answers:

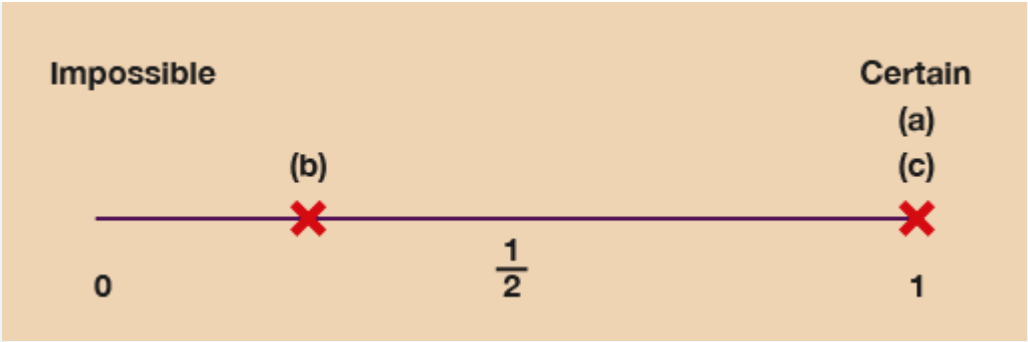


Figure 25 A probability scale (answer)

Of course, if you are a long-distance runner or plan to be one, your location for (b) might be closer to 1!

For some events it is not possible to give an exact probability of an outcome. In the example above, you had to use your knowledge to estimate the probability of you running in the London Marathon. A friend may give a different probability!

Weather forecasters predict the weather in a similar way, looking at the available data and historical trends (patterns) to give the most probable weather predictions. Weather forecasting is not exact, so the forecasters use their knowledge to present a weather report that has the highest probability of occuring. Bookmakers use similar skills to set odds, looking at past results, current form, etc.

For some events, however, it is possible to give an exact probability of an outcome. Mathematically we can say that:

$$\text{The probability of something happening} = \frac{\text{The number of ways it can happen}}{\text{The number of possible outcomes}}$$

Example: Types of probability

What is the possibility of tossing a coin and getting heads?

How many ways can it happen? One way: in this example, it's either heads or it's not.

How many possible outcomes are there? When we toss a coin there are two possible outcomes: heads or tails.

So the probability of tossing a coin and getting heads is one in two (that is, $\frac{1}{2}$, 50% or 0.5).

What is the possibility of rolling a dice and getting a 6?

How many ways can it happen? One way: either it's a 6 or it's not.

How many possible outcomes are there? There are six numbers on a dice, so there are six possible outcomes.

So the probability of rolling a 6 on a dice is one in six.

What is the possibility of rolling a dice and getting an even number?

How many ways can it happen? There are three different ways we could roll an even number: the even numbers on a six-sided dice are 2, 4 and 6.

How many possible outcomes are there? There are six numbers on a dice, so there are six possible outcomes.

So the probability of rolling an even number on a die is three in six, which we can simplify to one in two ($\frac{1}{2}$, 50% or 0.5).

What is the probability of spinning an A?

In some situations the possibilities are *not* equally likely. Look at this spinner:

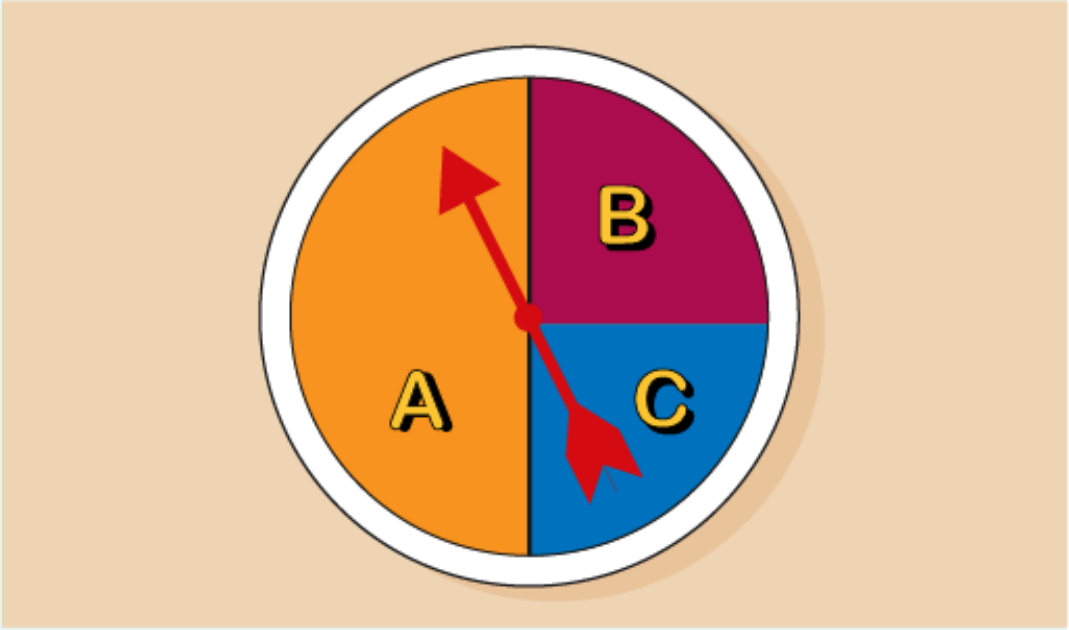


Figure 26 Spinner

How many ways can it happen? One way: either you spin an A or not.

How many possible outcomes are there? The spinner has three numbers, but they are not all the same size – so the possibility of spinning an A is not one in three. We can see that section A of the spinner is twice as big as sections B and C, and takes up half of the spinner. So the probability of spinning an A is half, or one in two ($\frac{1}{2}$, 50% or 0.5).

Activity 20: Calculating probability

1. What is the probability of Huw rolling a dice and getting an odd number?
2. Nancy is playing cards. What is the probability of her selecting:
   a. a red card from the deck of playing cards?
   b. an ace from the deck of cards?
   c. a heart from the deck?

3. Harrison puts the letters that spell his name into a bag. What is the probability that he will pick out an R?
4. David has designed a wheel of fortune to use in the school fete. What is the probability of spinning a win?

Figure 27 Wheel of fortune

Answer

1. *How many ways can it happen?* There are three different ways that we could roll an odd number on a six-sided dice: a 1, 3 or 5.
   How many possible outcomes are there? There are six numbers on a dice, so there are six possible outcomes.
   So the probability of rolling an odd number on a dice is three in six, which we can simplify to one in two ($\frac{1}{2}$, 50% or 0.5).

2. The answers are as follows:
   a. *How many ways can it happen?* There are 26 red cards in a deck of playing cards.
      How many possible outcomes are there? There are 52 cards in a deck, so there are 52 possible outcomes.
      So the probability of selecting a red card is 26 in 52, which we can simplify to one in two ($\frac{1}{2}$, 50% or 0.5).

   b. *How many ways can it happen?* There are four aces in a deck of playing cards.
      How many possible outcomes are there? There are 52 cards in a deck, so there are 52 possible outcomes.
      So the probability of selecting a red card is 4 in 52, which we can simplify to 1 in 13.

c. *How many ways can it happen?* There are 13 hearts in a deck of playing cards.

How many possible outcomes are there? There are 52 cards in a deck, so there are 52 possible outcomes.

So the probability of selecting a heart is 13 in 52, which we can simplify to one in four ($\frac{1}{4}$, 25% or 0.25).

3. *How many ways can it happen?* There are two Rs in the name ‘Harrison’, so there are two ways that it can happen.

How many possible outcomes are there? There are eight letters in the name ‘Harrison’, so there are eight possible outcomes.

So the probability of selecting an R is two in eight, which we can simplify to one in four ($\frac{1}{4}$, 25% or 0.25).

4. *How many ways can it happen?* There are four ‘winner’ sections, so there are four ways it can happen.

How many possible outcomes are there? There are 16 sections, so there are 16 sections that the spinner could land on.

So the probability of David spinning a win is 4 in 16, which we can simplify to one in four ($\frac{1}{4}$, 25% or 0.25). The winning section covers a quarter of the spinner.

Summary

In this section you have:

- learned about the possibility of different events happening
- shown that some events are more likely to occur than others.

11 Session 4 quiz

Now it’s time to complete the end-of-course quiz. It’s similar to previous quizzes, but in this one there will be 15 questions.

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.

12 Session 4 summary

You have now completed Session 4, ‘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:

- extract and interpret information from tables, diagrams, charts and graphs
- collect and record discrete data, and organise and represent information in different ways
- find the mean and range of a group of numbers
- use data to assess the likelihood of an outcome.

All of the skills listed above will help you when booking a holiday, reading the paper or analysing outcomes within your place of work.

13 Bringing it all together

Congratulations on completing *Everyday maths 1*. 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 understanding negative numbers in practical contexts
- adding, subtracting, multiplying and dividing whole numbers using a range of strategies
- understanding and using equivalences between common fractions, decimals and percentages
- adding, subtracting, multiplying and dividing decimals up to two decimal places
- solving simple problems involving ratio
- solving problems requiring calculation with common measures, including time, length, weight, capacity and temperature
- converting units of measure in the same system
- extracting and interpreting information from tables, charts and graphs
- collecting and recording discrete data, and organising and representing information in different ways
- finding the mean and range of a group of numbers
- using data to assess the likelihood of an outcome
- identifying various shapes
- working with area and perimeter, and scale drawings.

14 Next steps

You may now want to develop your everyday maths skills further. If so, you should look into the *Everyday maths 2* course, coming soon on OpenLearn. *Everyday maths 2* with give you the opportunity to look at some of the topics you've explored here in more detail, as well as new content such as calculating capacity.

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 1 Essential Skills (ESW) qualification in maths, which will enhance your CV.

- **Coleg Cambria** • https://www.cambria.ac.uk/ • 0300 30 30 007
- **Addysg Oedolion Cymru | Adult Learning Wales** • https://www.adultlearning.wales/ • 03300 580845
- **Coleg Gwent** • https://www.coleggwent.ac.uk/ • 01495 333777
- **NPTC Group of Colleges** • https://www.nptcgroup.ac.uk/