

Grade 3 Math

Reading the Scale

42 sheets · every strand · a much bigger year

THIS BOOK BELONGS TO

Find your scale



Number

to 1000 · rounding · $\times$ and $\div$ · fractions written properly

Sheets 1–16



Algebra

patterns with rules · tables of values · loops

Sheets 17–21



Data

tree diagrams · scaled graphs · the mean

Sheets 22–27



Spatial Sense

solids · perimeter · area · angles · mass · time

Sheets 28–39



Money

working out the change

Sheet 40

Things that are brand new this year

Rounding

to the nearest ten or hundred

Perimeter and area

the fence and the grass

Angles and mass

comparing and balancing

Numbers to 1000

hundreds, tens and ones

Telling the time

hours, minutes and seconds

The mean

what "average" really means

Column adding

and knowing why it works

mm and km

tiny units and huge ones

Loops in code

repeat instead of repeating

You are allowed to stop. If a sheet is too much, do half, or do the parts you like, or put it away and come back another day. Nothing here has to be finished in one go. Some of these are meant to be hard.

For the grown-up Two things to know before you start. First, Grade 3 requires recall of the **2, 5 and 10 times tables only** — all the facts to 10×10 are a Grade 4 expectation, so sheet 7 is deliberately narrow. Second, **measurement is the biggest section of the year**: nine expectations, sheets 32–39. If one term feels harder than the others, that will be why.



Hundreds, tens and ones – up to 1000

Count the blocks in each box. Write how many hundreds, tens and ones, then the whole number.

count

write

☒ The four block sizes



one
1



a rod of ten
10

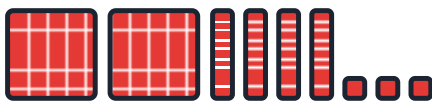


a flat of a hundred
100

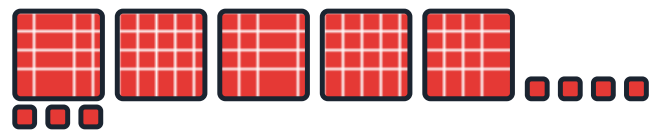


a big cube
1000

Ten ones make a rod. Ten rods make a flat. Ten flats make the big cube. Every step is ten times bigger than the last one.



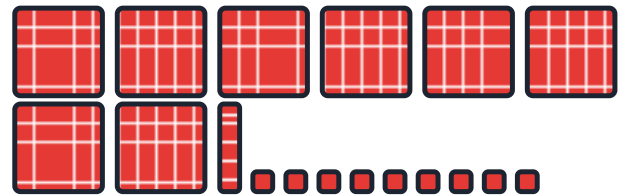
H T O =



H T O =



H T O =



H T O =

Now you draw the blocks

A square for a hundred, a tall line for a ten, a dot for a one. Keep it quick.

Draw 472



Draw 605



Draw 940



Two of these were tricky. One had no rods and one had no ones. When a place is empty you must still write a 0 there, or the whole number changes into something else.

For the grown-up Real base ten blocks, if you have them, are worth using here — the physical difference between ten rods and one flat is the whole idea. The two boxes with an empty place are the diagnostic: a child who writes 57 instead of 507 has a place-value gap, not a counting one.

B1.1 · B1.5



The zero has a job

Fill in every row of the table. The first row is done for you.



write



say it out loud

Number	H	T	O	In pieces	In words
407	4	0	7	$400 + 7$	four hundred and seven
470					
740					
704					
316					
	9	0	0		
				$600 + 50 + 2$	
					one hundred and eighty

Same three digits, four different numbers

All four of these use only 4, 0 and 7. Put them in order from smallest to biggest.

407

470

740

704

 ▶ ▶ ▶

The digits are identical. Only where they sit is different — and that changes everything. In 407 the 4 is worth 400. In 740 it is worth only 40.

Which digit is worth the most?

Circle the digit worth the biggest amount — not the one that looks biggest.

298

907

139

852

419

In 298 the 9 looks biggest, but the 2 is worth 200. Write what the circled digit is worth each time:

For the grown-up Reading numbers aloud is the fastest way to catch a place-value gap, because "four hundred and seven" and "forty-seven" sound nothing alike. The 407/470/740/704 set is deliberately narrow: identical digits, four values, one idea.

B1.1 · B1.2 · B1.5



Which is bigger?

Write $>$, $<$ or $=$ in each box. Check the hundreds first, then the tens, then the ones.



write



compare

☒ A reminder about which way round

The pointy end always points at the smaller number. Some people think of it as a mouth that opens towards the bigger one:
 $346 < 463$.

Start at the left. Compare the hundreds. Only if they're the same do you look at the tens.

346 463781 718509 590640 604275 27599 108830 831000 999412 421

Smallest first

596 · 65 · 659 · 569 · 950

Biggest first

700 · 70 · 707 · 770 · 77

Mystery numbers

Use every clue. Only one number fits each one.

1. I am between 400 and 500. My tens digit is 6. My digits add up to 13. I am

2. I have 7 hundreds and no tens. I am odd. My ones digit is 5. I am

3. I am 100 more than 638. I am 4. I am 10 less than 400. I am



Your turn

Write a mystery number of your own with three clues. Check that only one number fits.

For the grown-up 830 versus 83 is the one to watch — a child comparing digit by digit without checking length may say they're equal. Ask "how many hundreds does each have?" and it resolves instantly. Question 4 is a deliberate trap: 10 less than 400 crosses a hundred boundary, which is harder than it looks.

B1.2



Rounding to the nearest ten ★ brand new

For each number line, decide which end the yellow dot is closer to. Write the rounded number.

8 look

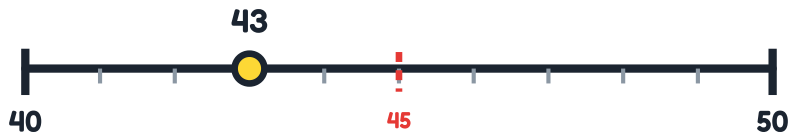
write

✓ What rounding actually is

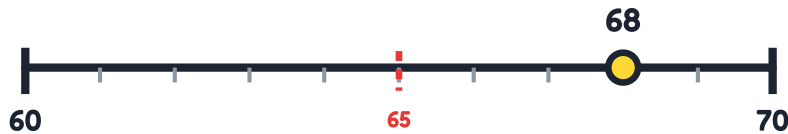
Rounding means swapping a number for a nearby, tidier number. You do it when close enough is more useful than exact — "about 300 people came," not "there were 287 people."

Put the number on a line between the two tens either side. Then just look: which end is it nearer?

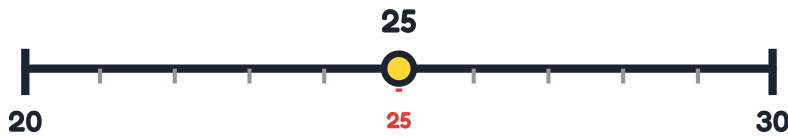
The red dashed line is the halfway mark. If a number lands exactly on it, we round up.



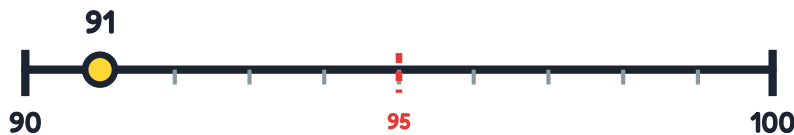
Is 43 closer to 40 or to 50? 43 rounds to



Is 68 closer to 60 or to 70? 68 rounds to



Is 25 closer to 20 or to 30? 25 rounds to



Is 91 closer to 90 or to 100? 91 rounds to

Bigger numbers, same idea



234 rounds to



Rounding to the nearest hundred

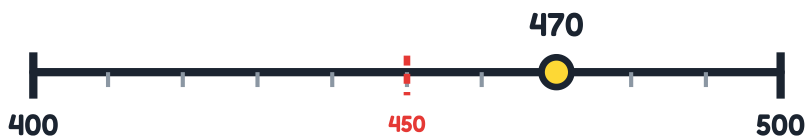
Same job, bigger jumps. Decide which hundred each number is closer to.

8 look

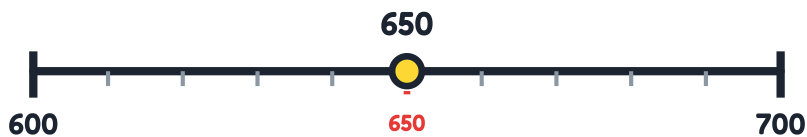
write



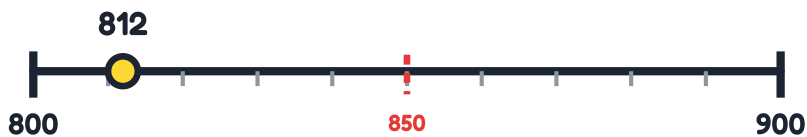
Is 340 closer to 300 or to 400? 340 rounds to



Is 470 closer to 400 or to 500? 470 rounds to



Is 650 closer to 600 or to 700? 650 rounds to



Is 812 closer to 800 or to 900? 812 rounds to

The exactly-halfway ones



250 rounds to

250 sits exactly on the dashed line. It is the same distance from 200 as it is from 300, so there is no "nearer" end. The agreed rule is to round up. It is a decision people made, not something you can work out — so it just has to be remembered.

Now without a line

For the nearest hundred you look at the tens digit.



Big jumps to 1000

Fill in the missing numbers in each row.

8

count



write



chant it

By 100s – all the way to 1000

100

200

400

600

1000

By 200s



new

200

600

By 50s from 500

500

550

650

800

1000

Backwards by 100s



harder

1000

800

500

Which count would you say it in?

Tick every count that includes the number. Some belong to more than one.

Number	By 50s	By 100s	By 200s
750			
400			
300			
1000			

How many jumps?

From 0 to 1000 in 100s: jumps

From 0 to 1000 in 200s: jumps

From 0 to 1000 in 50s: jumps

From 0 to 1000 in 500s: jumps

Notice the pattern: bigger jumps means fewer of them. You will meet that idea again when you start measuring things.

For the grown-up Chanting these in the car genuinely works and takes no preparation. Counting *backwards* is markedly harder and is what subtraction rests on, so it earns its own row. The “how many jumps” section quietly previews the inverse relationship between unit size and count — the same idea that dominates the measurement sheets later in this book. B1.4



Secret picture: 2s, 5s and 10s

Work out every answer. Colour each square using the key. Something is hiding in there.

8 work it out

colour

2 to 10	12 to 30	35 to 50	60 to 100						
2×1	1×2	2×2	2×3	2×6	6×2	3×2	2×4	4×2	2×5
5×2	5×1	1×5	2×7	7×2	2×8	8×2	10×1	1×10	2×1
1×2	2×2	2×3	2×9	5×7	7×5	9×2	3×2	2×4	4×2
2×5	5×2	2×10	10×2	5×8	8×5	5×3	3×5	5×1	1×5
10×1	1×10	5×4	4×5	5×5	5×6	6×5	10×3	2×1	1×2
2×2	2×3	3×10	2×6	6×2	2×7	7×2	2×8	3×2	2×4
4×2	8×2	2×9	9×2	2×10	10×2	5×3	3×5	5×4	2×5
4×5	5×5	5×2	5×6	6×5	10×3	3×10	5×1	2×6	6×2
1×5	10×1	1×10	10×6	6×10	10×7	7×10	2×1	1×2	2×2
2×3	3×2	2×4	4×2	10×8	8×10	2×5	5×2	5×1	1×5



Every single fact on this page comes from the 2, 5 or 10 times table. Those three are the ones Grade 3 needs to know by heart — not all of them. Get these three completely automatic and next year gets much easier.

Time yourself and try again in a week: Try 1 Try 2 Try 3

For the grown-up Watch for hesitation, not just errors — a fact recalled after three seconds of counting is not yet fluent. The 2s usually come first, the 10s almost free, and the 5s last. Note which squares come out the wrong colour: those are exactly the facts to drill, and there will only be a handful.

B2.2



Every times fact has a divide twin

Fill in both facts in each pair. They use exactly the same three numbers.

work it out

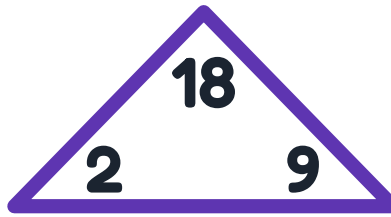
write

☒ Why this halves how much you have to learn

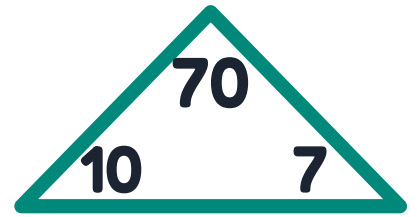
If you know $5 \times 4 = 20$, then you already know $20 \div 5 = 4$ and $20 \div 4 = 5$. You do not have to learn them separately. When you get stuck on a division, flip it into a multiplication and ask the easier question: for $35 \div 5$, ask "5 times what makes 35?"



$___ \times ___ = ___$
 $___ \times ___ = ___$
 $___ \div ___ = ___$
 $___ \div ___ = ___$



$___ \times ___ = ___$
 $___ \times ___ = ___$
 $___ \div ___ = ___$
 $___ \div ___ = ___$



$___ \times ___ = ___$
 $___ \times ___ = ___$
 $___ \div ___ = ___$
 $___ \div ___ = ___$

Divide facts to know by heart

$16 \div 2 = \dots\dots\dots$

$25 \div 5 = \dots\dots\dots$

$30 \div 10 = \dots\dots\dots$

$12 \div 2 = \dots\dots\dots$

$40 \div 5 = \dots\dots\dots$

$100 \div 10 = \dots\dots\dots$

$20 \div 2 = \dots\dots\dots$

$45 \div 5 = \dots\dots\dots$

$90 \div 10 = \dots\dots\dots$

$14 \div 2 = \dots\dots\dots$

$15 \div 5 = \dots\dots\dots$

$60 \div 10 = \dots\dots\dots$

Find the missing number

$2 \times \boxed{} = 14$

$\boxed{} \div 5 = 6$

$10 \times \boxed{} = 80$

$50 \div \boxed{} = 10$

$\boxed{} \times 5 = 35$

$18 \div \boxed{} = 9$

$\boxed{} \div 10 = 4$

$5 \times \boxed{} = 50$



A shortcut worth noticing. Dividing by 2 is the same as halving. Dividing by 10 just takes the zero off the end — $70 \div 10 = 7$, $90 \div 10 = 9$. That one feels like cheating, but it works because of place value.

For the grown-up The flip-it strategy is the single most useful thing here: "5 times what makes 35?" is a much easier question than "35 divided by 5" for most eight-year-olds, and it's the same question. The missing-number section is harder than plain facts and is what actually builds fluency.

B2.1 · B2.2



Rows and columns

For each array, write the two multiplications it shows.



count



write



shade



One array, two multiplications



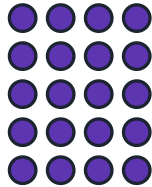
Read it as rows: 2 rows of 5, so $2 \times 5 = 10$.

Read it as columns: 5 columns of 2, so $5 \times 2 = 10$.

Same array, same total. You can multiply in either order and the answer never changes.



$\begin{array}{r} _ \times _ = _ \\ _ \times _ = _ \end{array}$



$\begin{array}{r} _ \times _ = _ \\ _ \times _ = _ \end{array}$



$\begin{array}{r} _ \times _ = _ \\ _ \times _ = _ \end{array}$

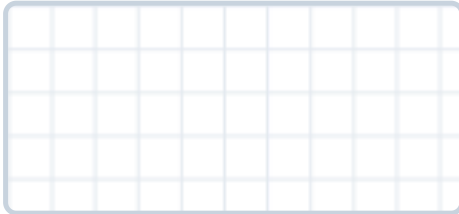


$\begin{array}{r} _ \times _ = _ \\ _ \times _ = _ \end{array}$

Shade the array on the grid

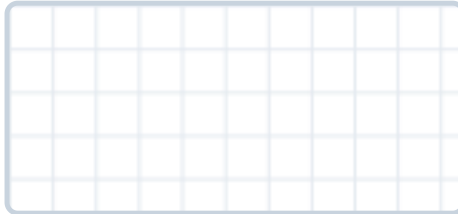
Shade a solid rectangle for each one, then write the total.

4 rows of 7



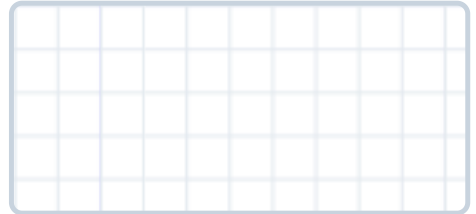
=

6 rows of 6



=

9 rows of 3



=

You have just measured a rectangle by counting squares. That is exactly what area is — and you will meet it properly on sheet 35.

Same total, different arrays

There are 24 counters. Find four different arrays that use exactly 24.

$_ \times _$

$_ \times _$

$_ \times _$

$_ \times _$

**Tricky**

Now try 23 counters. How many different arrays can you make? Why is that?

For the grown-up Twenty-three makes only one array (1×23) because it's a prime number — she doesn't need the word, but the discovery is real and worth pausing on. The grid-shading section is a deliberate bridge: arrays and area are the same structure, and meeting that connection now makes area easier in twenty sheets' time.

B2.6 · E2.7



Real problems, times and divide

Read each problem. Draw or write how you worked it out, then write the answer.

8 work it out

draw

write

Which words tell you what to do

each → equal groups

altogether → a total

shared → divide

how many groups → divide

every → equal groups

left over → a remainder

Words are a clue, not a rule. Always ask yourself what is **actually happening** in the story before you pick.

- 1 There are 7 boxes of crayons. Each box has 10 crayons. How many crayons altogether?

..... crayons

- 2 35 apples are shared equally into 5 baskets. How many in each basket?

..... apples

- 3 Chairs are put out in rows of 8. There are 6 rows. How many chairs?

..... chairs

- 4 27 marbles go into bags of 5. How many full bags, and how many left over?

..... bags, left

Groups of a half, a third and a quarter

You can have groups of half a thing. Six halves make three wholes. Draw each one and see.

Ravi has 6 half-sandwiches. How many whole sandwiches is that?

.....

A pizza is cut in quarters. There are 8 quarter slices. How many whole pizzas?

.....

A ribbon is cut into thirds. Amara has 9 thirds. How many whole ribbons?

.....



Now try 5 half-sandwiches. That is whole sandwiches. The answer is not a whole number, and that is fine — write what it really is.

- 5 Two steps. A bag holds 10 stickers. Priya buys 4 bags and then gives 7 stickers away. How many has she got left?

Step 1 — how many did she start with?

Step 2 — now take the 7 away.



In your head, up to 1000

Do these in your head. Then write which strategy you used from the yellow box.

8 think

write

Four strategies worth having

Hundreds first — $340 + 200$: add 3 hundreds and 2 hundreds

Bridge a hundred — $290 + 30$: hop to 300, then 20 more

Round and fix — $299 + 50$: add 300, then give 1 back

Doubles — $250 + 250$: you already know it

In your head	Answer	Which strategy, and why that one
$340 + 200$		
$450 + 130$		
$290 + 30$		
$299 + 50$		
$250 + 250$		
$375 + 25$		

Taking away in your head

$600 - 200 = \dots\dots\dots$

$480 - 150 = \dots\dots\dots$

$820 - 400 = \dots\dots\dots$

$505 - 5 = \dots\dots\dots$

$1000 - 250 = \dots\dots\dots$

$700 - 199 = \dots\dots\dots$

$700 - 199$ looks horrible and is actually the easiest one on the page. Take away 200 instead, then give one back. Why does giving one back make the answer bigger? $\dots\dots\dots$

Estimate first

Round each number to the nearest hundred, add those, and you have a rough answer in seconds. You are not being lazy — you are checking.

Problem	Rounded to hundreds	Estimate	Real answer
$312 + 289$	$300 + 300$	600	
$407 + 195$			
$638 + 149$			

If your real answer is nowhere near your estimate, something has gone wrong. That is the whole point of estimating.



Column adding – and why it works

☆ the big one

Read the three methods below. They are all the same sum. Then do the practice ones.

8 work it out

write

explain it

✓ One sum, three ways: $268 + 175$

1 · With blocks



3 flats, 13 rods, 13 ones.

13 ones is too many — swap ten of them for one rod.

Now 14 rods — swap ten for one flat.

Left with 4 flats, 4 rods, 3 ones.

2 · In pieces

$$200 + 60 + 8$$

$$100 + 70 + 5$$

$$300 + 130 + 13$$

Then tidy up:

$$300 + 130 + 13 = 443$$

3 · In columns

$$\begin{array}{r} \\ 268 \\ + 175 \\ \hline \end{array}$$

The little 1 you carry is not just a 1.

Carried from the ones, it means one ten.

Carried from the tens, it means one hundred.

The carried 1 is a swap. Ten ones become one ten; ten tens become one hundred. The column method is just the block-swapping, written down quickly.

Now these. Some need carrying, some don't.

$$\begin{array}{r} \\ 145 \\ + 232 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 356 \\ + 128 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 471 \\ + 260 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 268 \\ + 175 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 189 \\ + 234 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 507 \\ + 396 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 275 \\ + 725 \\ \hline \end{array}$$

One of these seven needed no carrying at all.

Which one?

Explain it to somebody

Pick any sum above where you carried. Point at the little 1 and say what it really means. Say it out loud to a grown-up, then write it here.

.....

.....

If you can explain *why* it works, you will never forget *how*. That is the whole reason this sheet has three methods on it instead of one.

For the grown-up

This is expectation B2.4, and it is the one most often skipped. Grade 3 isn't just expected to *execute* the column method — it's expected to connect it to blocks and to explain it. A child who can carry fluently but cannot say that the little 1 means one ten has met half the expectation, and will struggle when the numbers get bigger. Real base ten blocks for one sum is worth twenty practice questions.

B2.4 · B2.5



Column subtracting

Read the worked example, then do the practice ones.

8 work it out

write

✓ When the top digit is too small: $452 - 128$

$$\begin{array}{r} \\ 4 \ 5 \ 2 \\ - 1 \ 2 \ 8 \\ \hline \end{array}$$

In the ones column you need $2 - 8$, and 2 is not enough.

So go next door and **break open one ten**. The 5 tens become 4 tens, and those ten ones join the 2 to make 12.

Now $12 - 8 = 4$. Then $4 - 2 = 2$ tens. Then $4 - 1 = 3$ hundreds.

Nothing was added or removed — the 452 was just rearranged into 4 hundreds, 4 tens and 12 ones. It is still 452.

$$\begin{array}{r} \\ 4 \ 8 \ 6 \\ - 2 \ 5 \ 3 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 4 \ 5 \ 2 \\ - 1 \ 2 \ 8 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 6 \ 3 \ 4 \\ - 2 \ 7 \ 1 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 8 \ 0 \ 3 \\ - 1 \ 5 \ 7 \\ \hline \end{array}$$

The really tricky ones — borrowing past a zero

When the next-door column is a 0, there is nothing to break open. You have to go **two doors along** to the hundreds, break a hundred into ten tens, and *then* break one of those tens.

$$\begin{array}{r} \\ 5 \ 0 \ 0 \\ - 2 \ 4 \ 6 \\ \hline \end{array}$$

$$\begin{array}{r} \\ 1 \ 0 \ 0 \ 0 \\ - \ 3 \ 7 \ 5 \\ \hline \end{array}$$

Check $500 - 246$ by adding your answer to 246. Do you get back to 500?

.....

Try $1000 - 375$ a different way: count up from 375. Which way was easier?

.....

Spot the mistake

Somebody has done these two wrong. Find what went wrong and fix it.

$$\begin{array}{r} \\ 6 \ 3 \ 4 \\ - 2 \ 7 \ 1 \\ \hline 4 \ 4 \ 3 \end{array}$$

What went wrong?

The right answer is

$$\begin{array}{r} \\ 5 \ 0 \ 3 \\ - 1 \ 4 \ 8 \\ \hline 4 \ 4 \ 5 \end{array}$$

What went wrong?

The right answer is

For the grown-up

Borrowing across a zero is the hardest procedure in primary arithmetic and deserves its own box. The two wrong answers in the last section are the two classic errors: subtracting the smaller digit from the larger regardless of position, and mishandling the zero. Finding someone else's mistake is much harder — and more useful — than doing a fresh sum.

B2.4 · B2.5 · B2.1



Problems that need two goes

Each problem needs two calculations. Do step 1, then step 2, then write the answer.

 work it out

 write

 check

The trap on this page

The commonest mistake with two-step problems is **stopping after step 1**. You get a real number, it feels like an answer, and you write it down.

So before you write anything: **read the question again** and check it is asking what you have worked out. Then ask "does my answer make sense?"

- 1** A library has **348** books. **175** more arrive in a delivery. Then **62** books get borrowed. How many books are on the shelves now?

Step 1 — the delivery arrives

Step 2 — the borrowed ones leave

Answer: books

- 2** Class A collected **127** bottle caps. Class B collected **145**. They want **300** altogether. How many more do they need?

Step 1 — how many have they got?

Step 2 — how far off 300 is that?

Answer: more caps

- 3** Sam has saved **\$250**. He spends **\$85** on a scooter, then saves **\$120** more. How much has he got?

\$

- 4** A hall has **500** seats. **236** adults and **148** children come in. How many seats are empty?

..... seats

Check yourself

- ☐ I did both steps every time
- ☐ I read the question again before answering
- ☐ My answers have the right words with them
- ☐ None of my answers is silly-sized

"Silly-sized" means an answer that can't possibly be right — more seats empty than the hall holds, or Sam ending up with more money than he ever had. Noticing that is a real maths skill, not just carefulness.

For the grown-up If she stops after step 1, resist correcting immediately — instead read the question aloud again and ask "is that what it wanted?" Self-caught errors stick. The "silly-sized" check is estimation doing real work: a child who notices an impossible answer has understood the situation, not just the arithmetic.

B2.5 · B2.1



Sharing when it doesn't come out even

Draw the sharing for each one. Write how much each person gets.

 draw

 write

☒ You are allowed to cut things up

Share 9 pancakes between 2 people. Each gets 4 whole ones, and there is 1 left over. Cut it in half and they get half each.

So each person gets $4\frac{1}{2}$ pancakes. A number with a whole part and a fraction part is called a mixed number.

The old answer — "4 each with 1 left over" — is also correct. Which one you want depends on whether the thing can be cut.

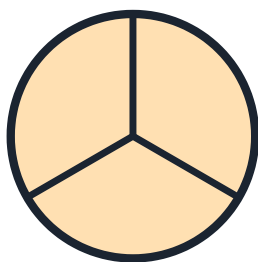
You can halve a pancake. You cannot halve a balloon.

Share this	Between	Draw it	Each one gets
12 grapes	4		
15 stickers	5		
18 marbles	6		
10 pizzas	4		
20 cupcakes	8		
14 oranges	4		

One third is the same as two sixths

Two cakes, both the same size. Share one between 3 people and one between 6 people.

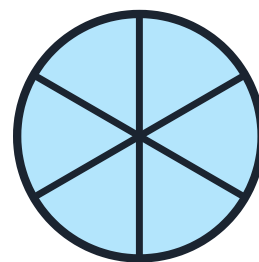
Shared between 3



Each person gets one third

$\frac{1}{3}$

Shared between 6



Each person gets one sixth

$\frac{1}{6}$

Colour one slice on the left cake. Now colour two slices on the right cake. Hold the page up to a window. Are the coloured bits the same size?

So $\frac{1}{3} = \frac{2}{6}$. Two sixths is exactly one third. The pieces are smaller, but you have twice as many.

A hard one to finish on

Share 20 cookies between 3 people. Each gets whole cookies, and then the leftovers get shared too.

The most surprising thing about fractions

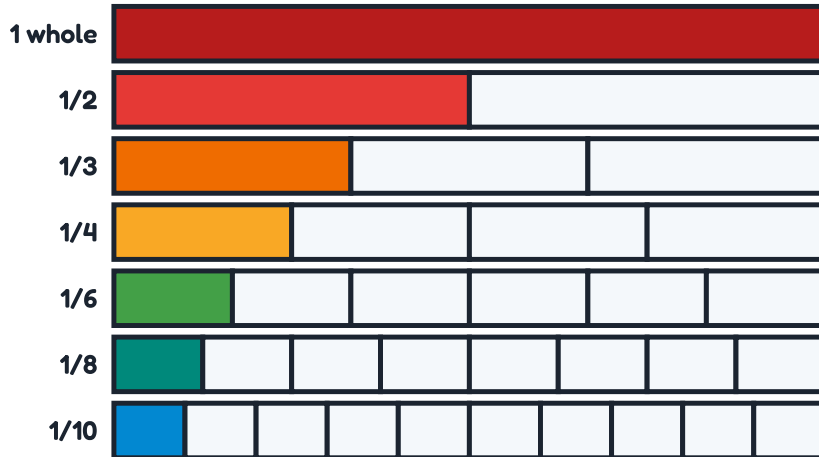
Look carefully at the coloured pieces. They get smaller as you go down. Read on to find out why.

 look

 write

 say why

One chocolate bar, shared different ways



Every bar is exactly the same length. The only difference is how many people are sharing it.

✔ **Why bigger bottom number means smaller piece**

Look at $\frac{1}{3}$ and $\frac{1}{8}$ on the picture above.

8 is a bigger number than 3 — but $\frac{1}{8}$ is a smaller piece than $\frac{1}{3}$.

That feels wrong, and almost everybody gets it wrong the first time. Here is the reason:

the bottom number tells you how many people are sharing. More people sharing the same bar means everybody gets less. Eight people sharing one bar do worse than three people sharing one bar.

Which is bigger?

Use the picture. Write $>$ or $<$.

$\frac{1}{3}$ $\frac{1}{8}$ $\frac{1}{2}$ $\frac{1}{4}$

$\frac{1}{10}$ $\frac{1}{6}$ $\frac{1}{4}$ $\frac{1}{3}$

$\frac{1}{6}$ $\frac{1}{8}$ $\frac{1}{2}$ $\frac{1}{10}$

Biggest piece first

Put these in order, biggest piece to smallest.

1/6 1/2 1/10 1/3 1/8

Notice: the bottom numbers end up in order smallest to biggest – the exact opposite way round.

Writing fractions properly

The bottom number is called the denominator — it says how many equal pieces the whole was cut into. The top number is the numerator — it says how many of those pieces you have.



This bar is cut into 6 pieces, so the denominator is 6.

3 of them are coloured, so the numerator is 3.

We write it **3/6**

And here is the useful bit: $\frac{3}{6} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6}$ — the numerator is just counting how many sixths you have. That's all a numerator ever does.



Growing patterns and tables of values

★ brand new

Look at how the tables and chairs grow. Fill in the table, then answer the questions.

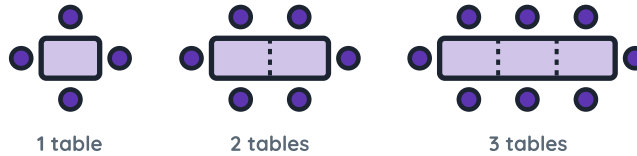
count

write

describe the rule

Party tables

Tables get pushed together in a long line. A chair goes on every free edge. Count the chairs each time.



1 table

2 tables

3 tables

A table of values

Tables	Chairs
1	4
2	6
3	
4	
5	
6	

What is the rule?

Each new table adds chairs.

Why isn't it 4 chairs each time? Two edges get hidden when tables join up.

Predict without drawing

10 tables would need chairs

20 tables would need chairs

How many tables for 16 chairs?

The last one runs the rule backwards.

A table of values is just a tidy way of writing a pattern down so you can see the rule.

Find the rule, then keep it going

Pattern	Missing numbers	The rule is...
3, 5, 7, 9, __, __		
4, 8, 16, 32, __		
100, 85, 70, 55, __, __		
150, 200, 250, __, __		
1000, 900, 800, __, __		
250, 275, 300, __, __		

Two of these get smaller, and one doubles instead of adding. A rule can be any operation — not just adding.



Three ways to show one pattern

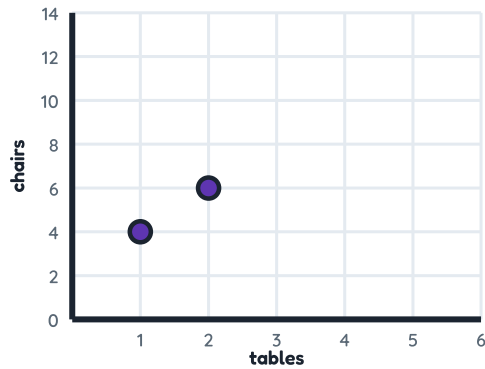
The same pattern can be a picture, a table, or a graph. Finish all three.

count

write

plot

The party tables again – as a graph



Two dots are already plotted: 1 table, 4 chairs and 2 tables, 6 chairs.

Add the dots for 3, 4 and 5 tables. Use your table of values from sheet 17.

Now look at your five dots. Do they make a straight line or a curve?

A pattern that adds the same amount every time always makes a straight line on a graph. That is a genuinely useful thing to know — you can spot the kind of rule just by looking at the shape.

Keep the chain going

Start at 8. Add 6 each time.

8

Start at 500. Take away 50 each time.

500

Start at 3. Double each time.

3

Start at 1000. Take away 200 each time.

1000

The third one doubles. Notice how much faster it grows than the ones that add — it starts as the smallest and would soon be the biggest.

Missing from the middle

These have gaps in the middle, not the end. Work out the rule first.

20, 30, _____, 50, _____

120, _____, 140, 150, _____

900, _____, 700, _____, 500

Make your own

Invent a pattern that starts small and ends up over 500. Write the first five numbers and your rule.

My rule:

Doubling gets there fastest. Adding tens takes ages. Try both and see.

For the grown-up Translating between picture, table and graph is expectation C1.2, and it's the part children find genuinely new this year. The straight-line observation is worth dwelling on — it's the first time a graph tells you something about a rule rather than just displaying numbers, and it's the seed of everything that comes later in algebra.

C1.2 · C1.3 · C1.4



When a letter means a number

★ brand new

In each question, work out what the letter or box stands for.

8 work it out

✎ write

💬 explain

✓ What a variable actually is

A variable is a letter or a box that stands in for a number you don't know yet, or a number that changes.

You have been using them for years without the name: $\square + 3 = 7$ has a box for the missing number. Writing $n + 3 = 7$ means exactly the same thing — the letter is just quicker to write.

The word variable comes from *vary*, which means change. That is the clue to what they are for.

Find the mystery number

$$n + 7 = 15 \quad n = \dots\dots\dots \quad n - 4 = 10 \quad n = \dots\dots\dots$$

$$5 \times n = 40 \quad n = \dots\dots\dots \quad n \div 2 = 9 \quad n = \dots\dots\dots$$

$$n + n = 16 \quad n = \dots\dots\dots \quad 100 - n = 65 \quad n = \dots\dots\dots$$

Now the other way round

You are told what the letter is. Work out the answer.

If $a = 6$, then $a + 10 = \dots\dots\dots$

If $a = 6$, then $a \times 5 = \dots\dots\dots$

If $b = 20$, then $b \div 2 = \dots\dots\dots$

If $b = 20$, then $b + b = \dots\dots\dots$

Notice a stayed 6 in both of its questions. A letter keeps the same value while you are working on one problem.

A variable that really does change

Remember the party tables? The rule was chairs = $2 \times \text{tables} + 2$. Here tables is a variable — it changes, and the number of chairs changes with it.

If tables =	1	2	5	8	10
then chairs =	4				

This is what variables are for: writing down one rule that works for every number, instead of a separate sum for each one. One short line replaces a hundred calculations.

Which letter is doing which job?

A shop sells pencils for 3 dollars each. The rule for the cost is $\text{cost} = 3 \times p$, where p is how many pencils you buy.

What does p stand for?

What does 3 stand for?

If $p = 4$, the cost is \$.....

If the cost was \$21, then $p = \dots\dots\dots$

The 3 never changes — pencils always cost 3 dollars. Only p changes. That is the difference between a number and a variable.

For the grown-up Grade 3 only needs to *describe how variables are used* — not solve equations formally. The last box is the whole expectation in miniature: telling apart the part of a rule that stays fixed from the part that varies. If she can say “ p changes but 3 doesn’t,” she has it.

C2.1



Keeping both sides the same

Each balance must stay level. Work out what goes in the box.

work it out

write

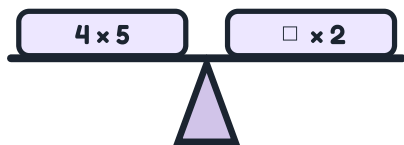
tick or cross

What the equals sign really means

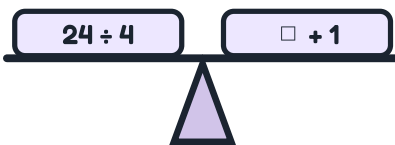
Most people read $=$ as "and the answer is". That is not quite right, and it causes trouble later.

$=$ means "these two sides are worth the same". It is a balance, not an arrow.

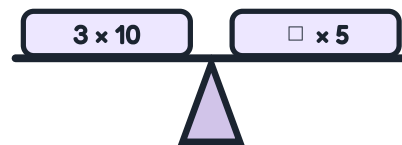
So $4 \times 5 = 10 \times 2$ is a perfectly good sentence. Both sides are 20. Nothing is being "worked out" — they are just equal.



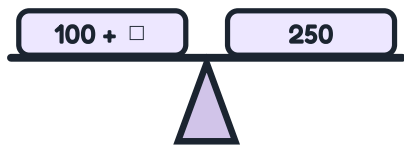
□ =



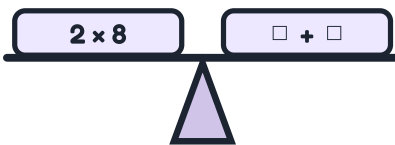
□ =



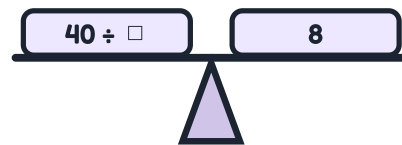
□ =



□ =



□ =



□ =

True or not true?

Work out both sides. Tick if they match, cross if they don't. Two of these eight are wrong.

$5 \times 4 = 20$

☐

$6 + 6 = 3 \times 4$

☐

$20 \div 2 = 5 \times 2$

☐

$300 + 200 = 600 - 100$

☐

$7 \times 2 = 10 + 5$

☐

$30 \div 5 = 2 \times 3$

☐

$250 + 250 = 400 + 100$

☐

$4 \times 5 = 2 \times 8$

☐

Bigger numbers, same idea

$350 + \square = 800 \quad \square = \dots\dots\dots$

$\square - 200 = 450 \quad \square = \dots\dots\dots$

$1000 - \square = 250 \quad \square = \dots\dots\dots$

$\square + 175 = 500 \quad \square = \dots\dots\dots$

Make it balance yourself

Fill each side so both are worth the same. There are lots of right answers — find one you like.

$12 = \dots\dots\dots \times \dots\dots\dots$

$\dots\dots\dots + \dots\dots\dots = 5 \times 4$

$20 \div 2 = \dots\dots\dots + \dots\dots\dots$



Loops: saying it once instead of four times

★ brand new

No computer needed. Use a pencil and move the robot square by square.

🚶 trace the path

✎ write

🔧 fix the bug

The four instructions

FORWARD 3

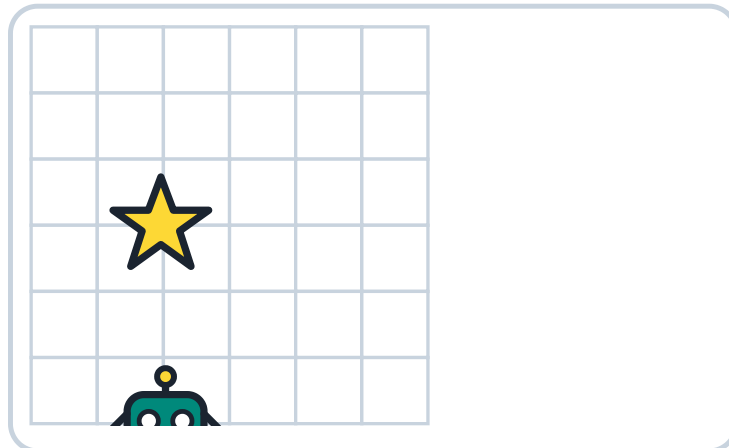
TURN LEFT

REPEAT 4 [...]

STOP

The robot always starts **facing right**. **TURN LEFT** turns it a **quarter turn** on the spot — it does not move.

1 • One step at a time



Trace this program with your pencil:

FORWARD 2

TURN LEFT

FORWARD 3

TURN LEFT

FORWARD 2

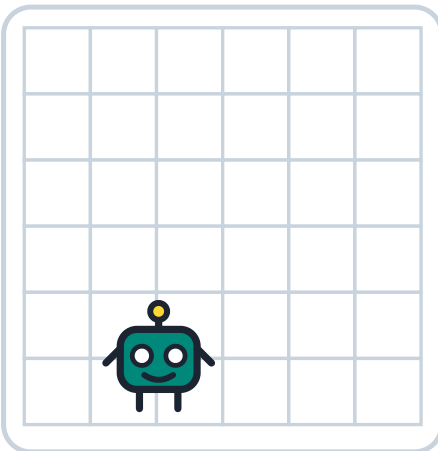
STOP

Where does the robot end up?

Which way is it facing at the end?

Instructions that happen **one after another** like this are called **sequential**. The order matters enormously — swap two lines and you end up somewhere else entirely.

2 • Now with a loop



These two programs do exactly the same thing:

FORWARD 3

TURN LEFT

FORWARD 3

TURN LEFT

FORWARD 3

TURN LEFT

FORWARD 3

TURN LEFT

REPEAT 4 [

FORWARD 3

TURN LEFT

]

Trace it on the grid. What shape does the robot draw?

Does it end up back where it started?

A loop is an instruction that says "do this bit again". It is shorter to write, easier to read, and much easier to change — and that last one is the real reason programmers love them.

3 • Change one thing

What if you changed it to **REPEAT 4 [FORWARD 5, TURN LEFT]**?

4 • Find the bug

This program was meant to draw a square, but it doesn't:



Three ways to sort the same things

☆ tree diagrams are new

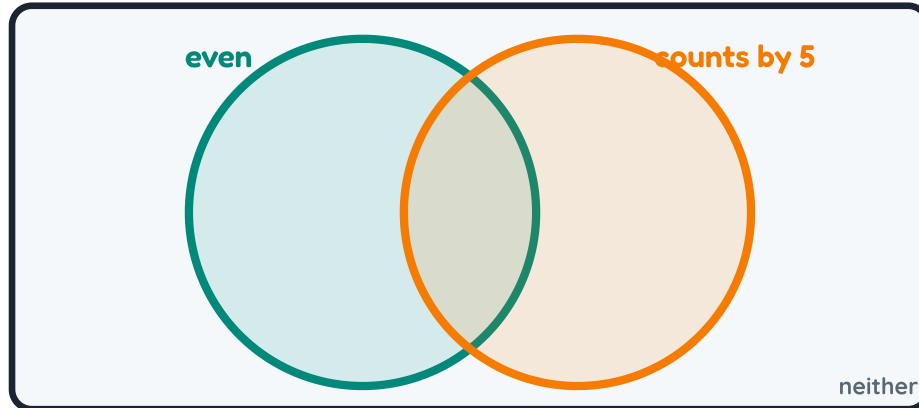
Sort the numbers 1 to 20 into each diagram. Every number goes somewhere.

✎ write

☒ check none are missing

1 · A Venn diagram

Numbers that are both go in the middle, where the loops overlap. Numbers that are neither go outside both loops but inside the box.



Two numbers belong in the very middle. Which are they?

2 · A Carroll diagram

The same job as the Venn, drawn as a grid. Some people find this one much easier to read.

	counts by 5	does not count by 5
even		
not even		

Both diagrams hold exactly the same information. Which did you prefer? There is no right answer to that.

Check your work

Count how many numbers you put in each part. They must add up to 20, because you started with 20 numbers.

Even but not by 5:

By 5 but not even:

Both:

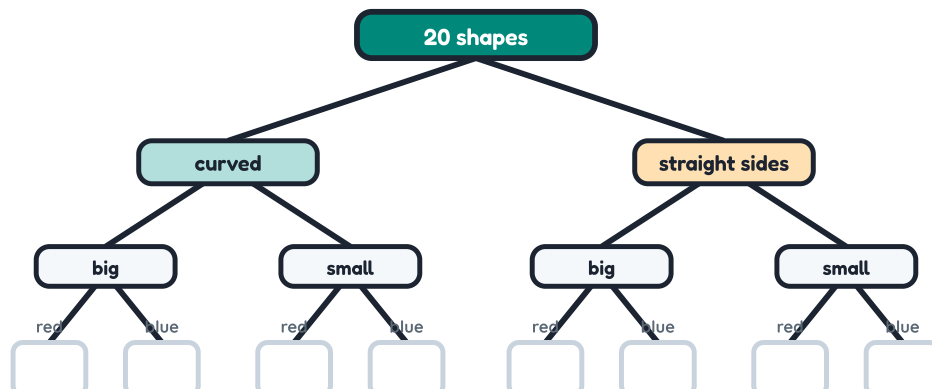
Neither:

Total:

If your total isn't 20, one number is in two places or has been left out. This check catches it every time.

3 · A tree diagram – sorting by three things

A tree asks one question at a time and splits into branches. Follow the branches down and write what kind of shape ends up at each tip.





Tally it up, then tidy it up

Count the fruit below. Make a tally, then fill in the frequency table.

8 count

write

Snack time – 24 pieces of fruit

Red = apple Yellow = banana Orange = orange Green = pear. Cross each one off as you count it, or you will lose your place.



A frequency table

Fruit	Tally	How many
apple		
banana		
orange		
pear		
Total		

Your total must be 24. If it isn't, count again — the table is telling you something is wrong.

Tally marks, properly

Four upright, then the fifth goes across the other four. That way you can count in fives instead of ones.



Read your table

Most common fruit:

Least common:

How many more apples than pears?

Apples and bananas together:

Two kinds of data ☆ new words

Words data

Answers are categories, not numbers.

Favourite colour. Type of pet. Way you get to school.

The proper word is **qualitative** — it describes a quality.

Number data

Answers are numbers you can count or measure.

How many pets. How tall you are. Minutes spent reading.

The proper word is **quantitative** — it tells a quantity.

Write W for words data or N for number data:

Favourite ice cream

Number of buttons on your coat

Eye colour

How many minutes you slept

Country you were born in

Shoe size

Now collect your own

Pick a question and ask at least 10 people. Write your question in the top box.

My question:

Answer

Tally

How many

When one picture means five

☆ brand new

Look at the key before you count anything. The key changes what every picture is worth.

- count
- draw
- write

Why not just draw one picture per book?

Room 2 read 35 books. Drawing 35 little books would take all afternoon and be impossible to count. So instead we say one picture = 5 books, and draw only 7 pictures. That rule is called the **key**, and it always sits at the bottom of the graph. Always read the key first. Without it, a pictograph tells you nothing at all.

1 · Draw this one yourself

Room 1 read 20 · Room 2 read 35 · Room 3 read 15 · Room 4 read 25 · Room 5 read 30.
Draw one square for every 5 books.

Class	Books read (one square = 5 books)
Room 1	
Room 2	
Room 3	
Room 4	
Room 5	

How many squares did Room 2 need? How did you work that out?

2 · Now read one – and watch for halves

This graph shows minutes spent reading. Here one whole bar = 10 minutes, so a half bar = 5 minutes.

Day	Minutes read	How many minutes?
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

Three days have a half bar on the end. Which days, and how much is that half worth?

Questions about your graphs

Change the key

Imagine the first graph used one square = 10 books instead of 5.



The same data can look very different

Both graphs below show exactly the same numbers. Look at the side of each one carefully.

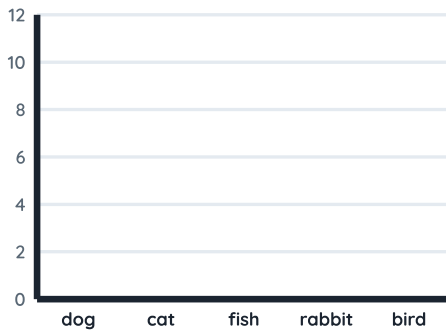
8 read the scale

draw bars

write

1 • Draw the bars

Pets in one class: 12 dogs, 8 cats, 6 fish, 4 rabbits, 2 birds. This graph goes up in 2s.



Because the graph counts in 2s, each line up the side is worth 2 pets, not 1. Halfway between two lines is an odd number.

Which pet is most common?

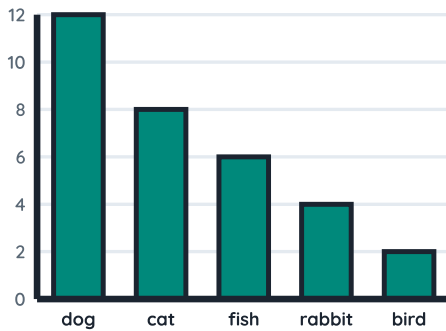
How many more dogs than birds?

How many pets altogether?

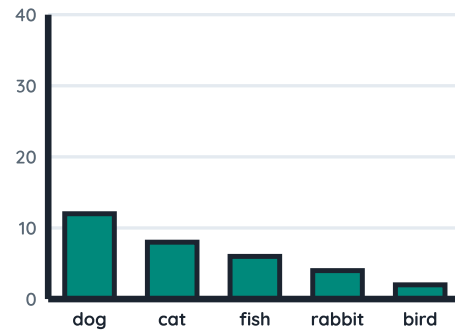
2 • Same numbers, two different scales

☆ important

Graph A — going up in 2s



Graph B — going up in 10s



In which graph does the difference between dogs and birds look bigger?

Is there actually a bigger difference in that graph?

How many dogs does Graph A show? How many does Graph B show?



Both graphs are telling the truth. Neither one is lying — but one makes the difference *look* much more dramatic. People who want to persuade you of something sometimes choose their scale on purpose. Now you know to look.

Choose a good scale

You want to graph these numbers: 5, 20, 45, 30, 15.

Going up in 1s would need lines. Too many?

Going up in 5s would need lines.

Going up in 50s would need lines. Too few?

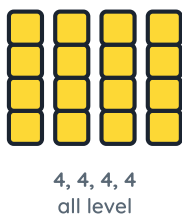
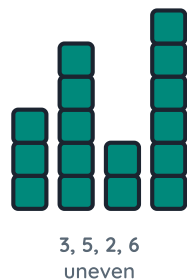
The mean: making everything level

brand new

Build the towers with real blocks if you can. Then move blocks until every tower is the same.

- build
- work it out
- write

The mean is just fair sharing



Four towers: 3, 5, 2, 6 blocks.
Move blocks from the tall ones to the short ones until they are all the same height.
They all end up 4 high. So the mean is 4.
The quick way: add them all up ($3+5+2+6 = 16$), then share between how many towers there are ($16 \div 4 = 4$). Same answer, less moving about.

No blocks were thrown away — there were 16 at the start and 16 at the end. That is why adding then dividing works.

Find the mean

Add them all, then divide by how many there are.

- 2, 4, 6 mean =
- 5, 5, 8 mean =
- 10, 20, 30, 40 mean =
- 7, 3 mean =
- 4, 4, 4, 8 mean =

The last one is interesting: three 4s and an 8. The mean is bigger than most of the numbers. One big value pulls the mean up.

Mode — the most popular one

The mode is simply the value that appears most often. You already know how to find it — now you know its name.

- 3, 7, 3, 9, 3 → mode =
- 5, 5, 2, 8, 8, 8 → mode =
- 10, 4, 10, 4, 10 → mode =

Look back at your fruit table on sheet 23. What was the mode of the fruit?

A real one

Five children counted how many books they read in March:

Ada	Ben	Cam	Dee	Eli
6	2	9	4	4

Total books:

How many children:

The mean is:

The mode is:

Did anybody actually read the mean number of books?
The mean does not have to be one of the real numbers. It is the fair share, not somebody's score.

Working backwards

Three towers have a mean of 5. Two of them are 3 and 4. How tall is the third?



How likely is it? ☆ a new word this year

Use one of the five words in the yellow box for every answer on this page.

look

write

say why

The five words, from never to always

impossible

unlikely

equally likely

likely

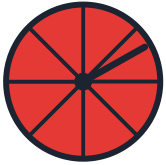
certain

Equally likely

is the new one this year. It means there is

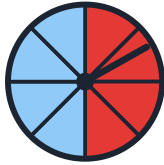
exactly the same chance

of it happening as of it not happening — a fair coin, a spinner that is half and half.



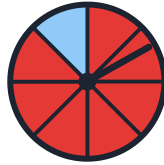
Landing on red is

.....



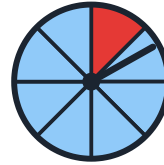
Landing on red is

.....



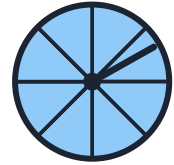
Landing on red is

.....



Landing on red is

.....



Landing on red is

.....

Each spinner is split into 8 equal parts. Count the red parts before you choose a word. The last spinner has no red at all.

Everyday chances

Choose one of the five words for each.

The sun will rise tomorrow

You will roll a 7 on a normal dice

A coin lands on heads

It will snow in Ontario in January

It will snow in Ontario in July

You will see a dog today

A bag of marbles

A bag holds 8 red marbles and 2 blue ones. You pull one out without looking.

Pulling out a red one is

Pulling out a blue one is

Pulling out a green one is

Now change the bag so red and blue are equally likely. How many of each would you need?

Test it for real

Flip a coin 20 times. Tally what you get.

	Tally	How many
heads		
tails		

Did you get exactly 10 and 10?

Probably not — and that is completely normal. "Equally likely" does not promise an even split every time. It means that over a very large number of flips they even out. Twenty is not very large.

Comparing two groups

Two classes were asked their favourite snack:



Faces, edges and vertices

Find a real object like each solid. Hold it while you count. Then fill in the table.

hold a real one

count

write

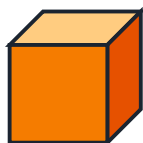
The three words

Face — a flat surface you could put a sticker on. A cube has six.

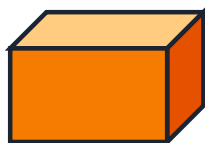
Edge — the line where two faces meet. You can run your finger along it.

Vertex — a corner where edges meet. More than one is **vertices**.

Count out loud and touch each one. Counting a cube's twelve edges from a picture is nearly impossible; counting them on a real box is easy, because you can turn it round.



cube



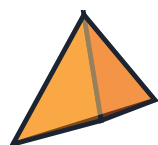
rectangular prism



triangular prism



square pyramid



triangular pyramid



cylinder



cone

Solid	Faces	Edges	Vertices	A real object like it
cube				
rectangular prism				
triangular prism				
square pyramid				
triangular pyramid				
cylinder				
cone				

The curved ones are different

A cylinder has two flat faces and one curved surface wrapped round the middle. It has no vertices at all — nowhere to prick your finger.

A cone has one flat face, one curved surface, and exactly one vertex — the point at the top.

Which of the two would roll if you pushed it?

Why?

A hidden pattern for a challenge

Take any solid with flat faces only. Work out:

faces + vertices – edges

Do it for the cube. Now the square pyramid. Now the triangular prism.

cube

.....

pyramid

.....

prism

.....



Unfolding a solid into flat shapes

A net is what you get if you cut a solid open and flatten it out.

cut and fold

match

write

☒ Every solid is made of flat shapes

Take an empty cereal box and cut along its edges until it lies flat. What you are left with is a **net**: six rectangles joined up. Every solid with flat faces can be unfolded like this. Looking at a net tells you **exactly** which two-dimensional shapes the solid is built from — and how many of each.

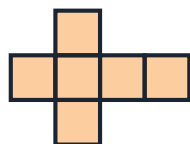
Which flat shapes make each solid?

Solid	Its faces are made of...	How many of each
cube	squares	6
rectangular prism		
square pyramid		
triangular prism		
cylinder		

The square pyramid needs two different shapes — one square and some triangles. So does the triangular prism. Write both kinds in the box.

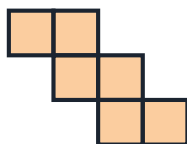
Will it fold into a cube?

All four nets below have exactly six squares. But only two of them fold up into a cube. Which two?



Net A
folds into a cube?

.....



Net B
folds into a cube?

.....



Net C
folds into a cube?

.....



Net D
folds into a cube?

.....

Don't just stare at them — trace them onto paper, cut them out, and try. Being right because you tested it is much better than being right because you guessed.

What goes wrong with the two that don't work?

Six squares is not enough

Having the right number of faces does not make a net work. They also have to be joined in the right places. If two faces would land on top of each other when you fold, the net fails — and you will always have a gap somewhere else.

There are eleven different nets that fold into a cube. Can you find one that isn't shown here? Draw it:

Build something

Make a solid out of nets, then answer these about it.

What did you build?

How many faces?

What shape are they?

Was anything harder than you expected?



Exactly the same: congruent shapes

Two shapes are congruent if one would fit perfectly on top of the other.

compare

trace and check

write

What congruent means – and what it doesn't

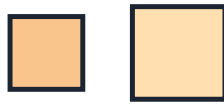
Congruent means same shape and same size. Nothing else has to match: the colour can be different, and one can be turned round or flipped over and still be congruent.

What is not allowed is making it bigger or smaller. A small square and a big square are the same *shape*, but they are not congruent.

The test: trace one onto tracing paper. Slide it, turn it, flip it. If you can make it sit exactly on the other with no bits sticking out, they are congruent.



Pair A
congruent?



Pair B
congruent?



Pair C
congruent?



Pair D
congruent?

Two of these four pairs are congruent. If you are not sure, trace and check — that is the proper way to decide, not squinting.

Congruent bits of a solid

Solids have congruent parts too. Pick up a real cube or a cereal box and check these:

On a cube, how many faces are congruent to each other?

On a cereal box, how many pairs of congruent faces?

On a triangular prism, which faces are congruent?

Hold the box and put the two ends together to check. Opposite faces of a box always match.

Congruent angles and lengths

Angles can be congruent too — that means they open by exactly the same amount.

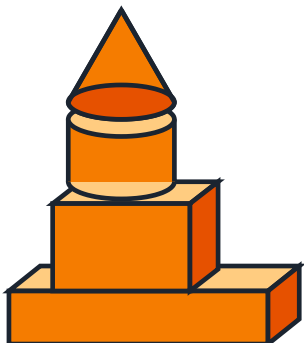
All four corners of a square are *****

On a cube, all twelve edges are *****

On a cereal box, are all the edges congruent? *****

A cube and a cereal box both have six faces and twelve edges — but only one of them has all twelve edges the same length. That is the whole difference between them.

What is this built from?



This tower is made by stacking solids on top of each other. Work out what each part is.

Solid	How many
rectangular prism	
cylinder	
cone	
cube	



Giving and following directions

Put your finger on the starting place. Follow each instruction one at a time.



follow the route



write



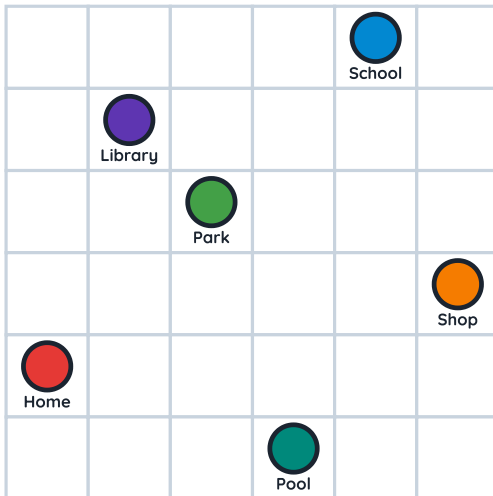
give directions

Turns

quarter turn = a right angle**half turn = all the way round to face backwards****two quarter turns = one half turn**

Stand up and try it.

Face a wall. Make a quarter turn left. Then another. You are now facing the opposite wall – that is why two quarters make a half.



north is up the page

Route A

Start at Home, facing east.

- Go forward 2
- Make a quarter turn left
- Go forward 2

You end up at

Route B

Start at Park, facing north.

- Go forward 2
- Make a quarter turn right
- Go forward 2

You end up at

Route C

Start at School, facing west.

- Go forward 2
- Make a half turn
- Go forward 3
- Make a quarter turn right
- Go forward 3

You end up at

Route D

Start at Shop, facing west.

- Go forward 2
- Make a quarter turn left
- Go forward 2

You end up at

Now you give the directions

Write instructions to get from the Pool to the Library. Say which way to face at the start.

.....

.....

Think about it

Route A ended at the Park. If you made a half turn there and went forward 2, where would you be?

Which two places are closest together?



Millimetres, centimetres, metres, kilometres

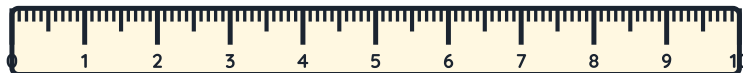
Use a real ruler for the measuring parts. The one printed here is for looking at.

measure

write

choose

Look closely at a ruler



The big numbered marks are centimetres. Between every pair of them are ten tiny marks — those are millimetres. The medium mark in the middle is the halfway point, 5 mm.

$$1 \text{ cm} = 10 \text{ mm}$$

How big is each one, really?

mm

About as thick as a fingernail or a coin. You use these for very small things.

cm

About as wide as your little finger. Good for pencils, books and hands.

m

About one big step, or the width of a door. Good for rooms and people.

km

About a ten minute walk. Good for how far away another town is.

Which unit would you use? Write mm, cm, m or km:

Length of a caterpillar

Height of your front door

Distance to the next city

Thickness of a coin

Length of a school bus

Width of your thumbnail

Measure these lines twice

Measure each line in centimetres, then write the same length in millimetres.

Line	in cm	in mm

Notice something. The line did not change at all, but the number got ten times bigger when you used millimetres.

Smaller unit → you need more of them. That is true for every measurement there is: your height in cm is a bigger number than your height in metres, even though you are the same height.

Swapping units

1 cm = mm

1 m = cm

1 km = m

4 cm = mm

3 m = cm

2 km = m

Go and measure

Pick the sensible unit yourself this time.

Thing	Measurement
your pencil	
this book	



All the way round

Perimeter is the distance all the way round the outside. Add up every side.

measure

add

write

☒ What perimeter is for

Imagine walking right round the edge of a field and back to where you started. How far did you walk? That is the **perimeter**. It is what you need for real jobs: **fencing a garden**, putting ribbon round a parcel, or **edging a picture frame**. All of those are "how much do I need to go round the outside".

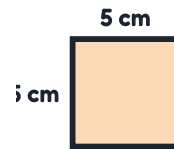
Start at one corner and go round in one direction, ticking off each side as you add it. That way you never miss one or count one twice.



perimeter = cm



perimeter = cm



perimeter = cm



perimeter = cm

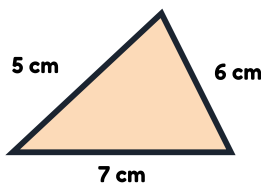
A shortcut for rectangles

A rectangle has two long sides and two short ones. So instead of adding four numbers, you can add the long and the short and double it.

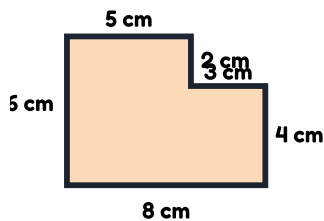
$$6 + 4 = 10 \rightarrow 10 \times 2 = 20 \text{ cm}$$

Check this against the first rectangle above. Did you get the same answer both ways? Which way did you find quicker?

Shapes with more sides



perimeter = cm



perimeter = cm

The L-shape has six sides. Tick each one as you add it — this is exactly where people lose track.

A surprise about the L

The L-shape fits inside a rectangle 8 cm by 6 cm. Work out that rectangle's perimeter: cm

Compare it with the L-shape's perimeter. What do you notice?

.....

They are the same. Cutting a corner out of a rectangle takes away some edge but adds exactly the same amount back. Try tracing round both with your finger and you will feel why.

Measure real things

Use a ruler or tape measure. Go round the whole edge.

Thing	Sides you measured	Perimeter
this book		
a table		



Working backwards from the perimeter

This time you are told the perimeter and have to find the shape.

8 work it out

draw

write

Find the missing side

Rectangle
perimeter 20 cm

One side is 6 cm.

The other is cm

Rectangle
perimeter 18 cm

One side is 5 cm.

The other is cm

Square
perimeter 24 cm

Every side is

..... cm

Triangle
perimeter 15 cm

Two sides are 4 and 6.

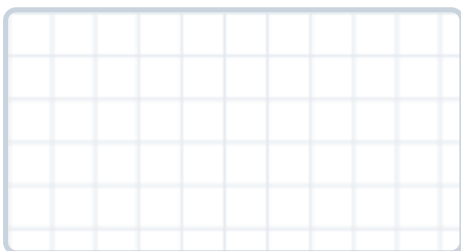
The third is cm

For the square, ask "what number times 4 makes 24?" For the rectangle, halve the perimeter first — that gives you one long plus one short.

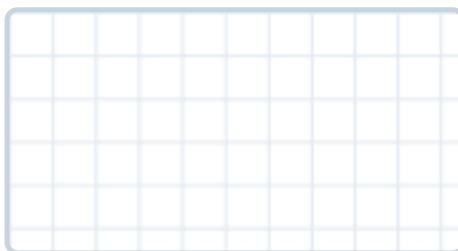
Build a shape with a given perimeter ☆ the hard bit

Each small square on the grid has sides 1 unit long. Draw a shape by going along the grid lines. Count the units round the outside.

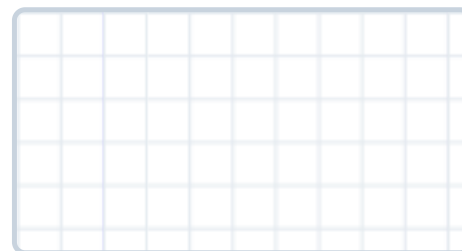
Perimeter of 12



Perimeter of 16



Perimeter of 16 again — but a different shape



There are lots of right answers for each one. A perimeter of 12 could be a 3x3 square, or a 2x4 rectangle, or a wiggly shape. Check yours by counting round the edge one unit at a time.

All the rectangles with perimeter 16

Use only whole numbers. Halve 16 to get 8, then find every pair that adds to 8.

Long side	Short side	Perimeter
7	1	16
		16
		16
		16

One of your four is a square. Which one?

A real problem

A vegetable patch is a rectangle 7 m long and 4 m wide. You want to put a fence all the way round.

How much fencing? m

Fencing costs \$3 a metre. Total cost: \$

Now imagine you leave a 1 m gap for a gate. How much fencing do you need then? m

Real jobs nearly always have a detail like that in them.

For the grown-up Constructing a shape to a given perimeter is explicitly in the expectation and is much harder than measuring one, because there's no single answer — some children find that unsettling and need reassuring that three different correct shapes really are all correct. Halving the perimeter first is the strategy that makes the rectangle questions tractable.

E2.1



Covering the inside

Area is how much space is inside a shape. Perimeter was the outside. These are different.

count

shade

write

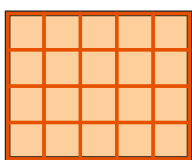
Outside or inside?

Perimeter is the fence round the garden. Area is the grass you have to mow.

You measure area by **covering the shape** and counting how many covers you needed. Back on sheet 9 you shaded rectangles on grid paper — that was area all along.

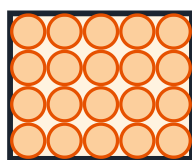
Not every cover works equally well

Here is the same rectangle, covered three different ways.



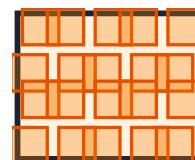
Squares, tidy

How many?



Circles

What is wrong?



Squares, overlapping

What is wrong?

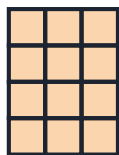
Gaps. Circles leave little empty bits between them. If you count 20 circles you have missed all the space in the gaps, so your answer is **too small**. Circles are a poor unit for area.

Overlaps. If the tiles sit on top of each other, some space gets counted twice. Your answer comes out **too big**.

A good unit for area tiles perfectly: no gaps, no overlaps, nothing hanging over the edge. That is why squares are used for area almost everywhere in the world.

Same area, different shape

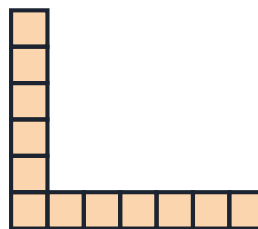
All three of these are made from the same number of squares. Count them and see.



area =



area =



area =

Did you expect the long thin one to have the same area as the fat one?

Shapes that look nothing alike can have exactly the same area. Only the number of squares matters.

Measure with your own units

Cover things with something you have lots of — sticky notes, playing cards, LEGO bricks, coins. Count how many it takes.

Thing	What I covered it with	How many it took
this page		
a chair seat		



Square centimetres and square metres

One square centimetre is a square that is 1 cm along each side. We write it cm^2 .

count

estimate

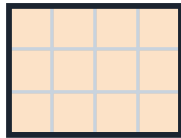
write

Reading cm^2 out loud

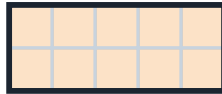
cm^2 is said "square centimetres". The little 2 does not mean multiply by two — it is there because area is measured in squares.

For big things we use m^2 , square metres. One square metre is a square one metre along each side — roughly the size of a small tabletop. You would measure a room in m^2 , not cm^2 , because it would take **ten thousand** square centimetres to fill one square metre.

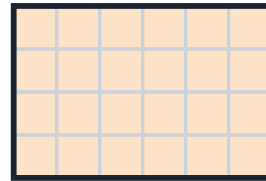
Count the squares



area = cm^2



area = cm^2



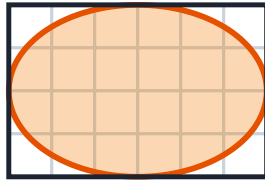
area = cm^2

The shortcut: you do not have to count them one by one. Count the squares along the top, count them down the side, and multiply. That is exactly the array work from sheet 9 doing a real job.

Check the last rectangle both ways — counting and multiplying. Same answer?

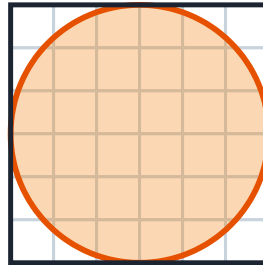
Shapes with curved sides

You cannot fit whole squares neatly inside a curve. So do this: **count all the whole squares first**. Then look at the part-squares round the edge and count a part as one if more than half of it is inside, and ignore it if less.



Whole squares:

About cm^2 altogether



Whole squares:

About cm^2 altogether

Your answer will be an estimate, and that is completely fine. Two sensible people counting the same curve will get slightly different numbers. Nobody is wrong — curves genuinely do not divide into whole squares.

Same area, different perimeter

All three rectangles have an area of 12 cm^2 . Work out the perimeter of each.

Sides	Area	Perimeter
1×12	12 cm^2	

Which unit — cm^2 or m^2 ?

A postage stamp

A bedroom floor

The cover of this book



How wide is the opening?

An angle is how far something has turned or how wide two lines open up.

make a tester

compare

write

☒ Make an angle tester first

Take any piece of paper. Fold it in half, then fold it in half again so the folds cross. Open it out slightly — the corner where the folds meet is a perfect **right angle**, exactly the same as the corner of this page.

Now hold that corner against any angle you meet. If the angle is **narrower** than your corner it is **less than a right angle**. If it is **wider**, it is **more**.

The length of the arms makes no difference at all. Only the **opening** counts — a long thin V and a short thin V are the same angle.



Angle A



Angle B



Angle C



Angle D



Angle E

Sort them with your tester

Which is **exactly** a right angle?

Which are **smaller** than a right angle?

Which are **bigger**?

Now put all five in order, smallest opening first:



Measuring with a wedge

Cut out a small paper wedge, all of them the same. Now find out how many wedges fit inside each angle. That is measuring with a non-standard unit — just like using paper clips to measure length.



← one wedge
this size

A right angle holds wedges

Angle A holds wedges

Angle D holds wedges

More wedges means a **bigger** angle. That is how measuring works, whatever you are measuring.

Angles all around you

Go and test real corners with your paper tester. Write right, smaller or bigger.

Corner of a door

Corner of this page

An open pair of scissors

Where two walls meet

A slice of pizza

Your elbow, bent

Your elbow and the scissors can be **any** angle you like — move them and the angle changes. That is worth noticing: an angle is about the **turn**, not about the object.

For the grown-up The persistent misconception is that longer arms mean a bigger angle. Drawing the same angle twice with very different arm lengths and asking which is bigger flushes it out immediately. The folded-paper right angle is a genuinely useful tool and worth keeping in the book — protractors and degrees are a Grade 6 matter.

E2.3



Which one is heavier?

A pan balance tips down on the heavier side. Look at which pan is lower.

make a balance

weigh

write

☒ Build a pan balance in five minutes

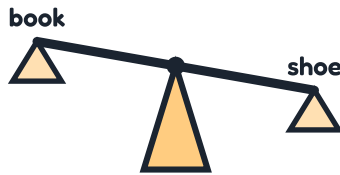
Hang a coat hanger somewhere it can swing freely. Tape a paper cup to each end. That is a working pan balance. Put an object in one cup. Drop identical small things — marbles, coins, dried beans, LEGO bricks — into the other cup until the hanger is level. Now you can say "this rubber is 7 marbles heavy".

Heavy and big are not the same thing. A big cushion is light. A small stone is heavy. Your hands know this, and a balance proves it.

Read the balances



Heavier:



Heavier:



These are

When the balance is level, both sides have the same mass. It does not mean both pans are empty — it means they match.

Working it out without weighing

You know two things:
The apple is heavier than the pear.
The pear is heavier than the plum.

So is the apple heavier than the plum?

Which is the lightest of the three?

Put all three in order, heaviest first:

.....

You worked that out without touching the balance. That is real reasoning, and it works for lengths and numbers too.

Weigh things for real

Object	My guess	Actually
a pencil		
a spoon		
an apple		
your own choice:		

I measured everything in
Guess before you weigh, every time. Your guesses will get much better by the fourth object.

Big units and small units again

Weigh the same object twice: once using marbles, once using something much lighter like dried beans.

My object:

It weighs marbles

It weighs beans

Which number came out bigger?

The object did not change. Lighter unit → you need more of them. That is the same rule you found with millimetres on sheet 32 — it turns up everywhere in measuring.



Hours, minutes and seconds

The short hand shows hours. The long hand shows minutes. Read the short one first.

 read the clock

 write

 count on

☒ Why the numbers mean two different things

The clock face has twelve numbers, but they do two jobs.

For the short hand, the 3 means 3 o'clock.

For the long hand, the 3 means 15 minutes — because there are five minutes between each pair of numbers, and $3 \times 5 = 15$. That is why the same "3" can mean 3 or 15. Count round the long hand in fives, exactly like the times tables you already know.



.....



.....



.....



.....



.....



.....

Write each time in the boxes. Do the short hand first, then count round in fives for the long hand.

Match the clock to the digital time



12:00



4:30



5:45



8:15

Draw a line joining each clock to its matching digital time. They are deliberately not in the same order. Digital clocks always write the minutes with two digits: five past eight is 8:05, never 8:5.

Draw the hands

Remember: short hand for hours, long hand for minutes.

Seconds

The thin fast hand counts seconds. It goes all the way round once every minute.

60 seconds = 1 minute

60 minutes = 1 hour

Working out the change

When you pay more than something costs, you get money back. That is the change.

count money

count up

write

Canadian coins



nickel



dime



quarter



loonie



toonie

Notice there is no one cent coin. Canada stopped making the penny in 2013. When you pay with cash the total gets rounded to the nearest five cents — which is why sheet 4's rounding turns out to be a shopping skill.

☒ The shopkeeper's trick: count up , don't take away

Something costs 65¢ and you pay with \$1. You could work out $100 - 65$, but there is an easier way that shopkeepers have always used.

Start at 65 and count up to 100, handing over coins as you go:

65 → 70 (5¢) → 75 (5¢) → 100 (25¢).

Add up what you handed over: $5 + 5 + 25 = 35¢$. That is the change, and you never had to borrow across a zero.

Whole dollars first

Costs \$7

You pay with \$10

Change: \$

Costs \$12

You pay with \$20

Change: \$

Costs \$6

You pay with \$10

Change: \$

Costs \$15

You pay with \$20

Change: \$

Now under a dollar

Costs 65¢

You pay with \$1

Change: ¢

Costs 40¢

You pay with \$1

Change: ¢

Costs 85¢

You pay with \$1

Change: ¢

Costs 25¢

You pay with \$1

Change: ¢

Count up, step by step

Show the counting-up steps for a 40¢ item paid with \$1:



Coins handed over:

Total change: ¢

There is more than one right way — you could give two quarters and a dime, or six dimes. Both come to 60¢.

Estimate before you pay

Round each price to the nearest dollar and add. You will know roughly what you owe before you reach the till.

Shopping	Rounded	Estimate
\$3 and \$6	\$3 + \$6	\$9
\$4 and \$9		
\$7, \$2 and \$5		

If you pay for the last one with a \$20 bill, roughly how much change? \$

Set up a shop

Put price labels on things around the house and use real coins if you have them. Take turns being the shopkeeper.

Puzzles that use the whole book

These are meant to be hard. Take as long as you like, and skip any you don't fancy.

8 think hard

write

talk it over

1 • The magic square

Fill in the empty squares using each of the numbers 1 to 9 exactly once, so that every row, every column and both diagonals add up to 15.

2		6
	5	
		8

Four numbers are already there. Start with a line that has two numbers filled in — there is only one number that can finish it.

2 • The mystery number

I am a three-digit number.

My hundreds digit is double my tens digit.

My ones digit is zero.

When you round me to the nearest hundred, you get 600.

I am

Work through the clues one at a time and cross out what each one rules out. The last clue is the most powerful — it means the number is between 550 and 649.

Now write a mystery number riddle of your own with three clues:

.....

.....

3 • The garden

A rectangular garden has an area of 24 square metres and a perimeter of 20 metres. Both sides are whole numbers of metres.

The sides are m and m

Try every pair of numbers that multiply to 24, and work out the perimeter of each. Only one pair fits both clues. Being systematic beats guessing here.

4 • Five coins

I have exactly five Canadian coins in my pocket, worth 70¢ altogether. Remember there is no penny.

Quarters:

Dimes:

Nickels:

There is only one answer. Start with the quarters — how many could there possibly be? Three quarters is already 75¢, which is too much.

5 • The handshake problem

Four people meet. Every person shakes hands with every other person exactly once. How many handshakes happen altogether?

Draw four dots and join every pair with a line. Count the lines.

Now build up a pattern:

People	Handshakes
2	1
3	3
4	

Six games with no worksheet at all

These all need another person. None of them need anything you have to buy.

 play with somebody

 get up and move

1 • Race to 1000

You need: a dice, paper, two players.

Take turns rolling. Each roll, you choose whether that number is worth ones, tens or hundreds — roll a 4 and you can score 4, 40 or 400. Add it to your running total.

First to land on exactly 1000 wins. Going over means you miss a turn.

The whole game is place value and mental addition, and the interesting bit is near the end, when you have to stop taking hundreds and start being careful.

2 • Twos, fives and tens snap

You need: a pack of cards with the picture cards taken out.

Deal the cards face down between two players. Both flip one card at the same time. Whoever first says the two numbers multiplied takes both cards.

To keep it to Grade 3 facts: take out everything except the aces, 2s, 5s and 10s. Now every question is from the three tables that actually have to be known by heart.

Add more numbers back in only when the first version is easy.

3 • Guess my rule

You need: nothing at all. Good in the car.

One player thinks of a rule — add 7, double it, take away 20 — and keeps it secret. The other player says a number, and the first player says what the rule turns it into.

Keep going until the guesser works out the rule. Then swap.

The good tactic is to try easy numbers first. Saying "1" and then "2" tells you far more than saying "37".

4 • Measurement treasure hunt

You need: a ruler or tape measure.

One player calls out a challenge. The other has one minute to find something that fits:

- something exactly 10 cm long
- something with a perimeter bigger than 50 cm
- something you would measure in millimetres
- two things with the same mass
- something with a right angle on it

Estimating first, then checking, is the point — not winning.

5 • Floor robot

You need: masking tape, an open floor, two people.

Tape a grid of big squares on the floor. One person is the robot and can only do exactly what they are told: *forward 2, quarter turn left, forward 3*.

The other person writes a program on paper first, then reads it out. No changing it halfway.

Put an object somewhere and try to reach it. Then try writing the same program using REPEAT to make it shorter.

Being a strict robot is the fun part. If the program says forward when there is a wall, the robot walks into the wall.

6 • Beat the clock

You need: a clock or timer with seconds.

Guess how long each of these takes, then time it and see how close you were:

- putting on your shoes
- writing your name ten times
- walking to the end of the garden and back
- tidying one shelf

Then the hard version: guess when a whole minute has passed with your eyes shut, and say stop. Almost everybody says stop far too early.

You got to the end

Forty-two sheets is a lot. Some of them were hard, and some of them probably went wrong the first time — that is what the rubbing-out is for.

The bits that were hardest are the bits where you learnt the most. Rounding, the fraction wall, column subtracting past a zero, the mean, area versus perimeter: none of those are easy, and you did them anyway.



Come back to any sheet whenever you want. There is nothing wrong with doing one twice — the second time is when it usually clicks.

Answers — Number, sheets 1 to 16

1 Blocks: 243 · 507 · 360 · 819. The two tricky ones are 507 (no rods) and 360 (no ones). Drawings of 472, 605 and 940 just need to show the right counts.

2 470 = 4,7,0 · 400+70 · four hundred and seventy. 740 = 7,4,0 · 700+40 · seven hundred and forty. 704 = 7,0,4 · 700+4 · seven hundred and four. 316 = 3,1,6 · 300+10+6. 900 = nine hundred. 652 = 6,5,2 · six hundred and fifty-two. 180 = 1,8,0 · 100+80.

Order: 407, 470, 704, 740.

Biggest-value digit: 2 in 298 (200) · 9 in 907 (900) · 1 in 139 (100) · 8 in 852 (800) · 4 in 419 (400).

3 < · > · < · > · = · < · > · > · <

Smallest first: 65, 569, 596, 659, 950. Biggest first: 770, 707, 700, 77, 70.

Mystery: 1 = **463** · 2 = **705** · 3 = **738** · 4 = **390**. The last one is the trap — it crosses a hundred.

4 43 → 40 · 68 → 70 · 25 → 30 · 91 → 90 · 234 → 230 · 587 → 590.

Digit rule: 50, 80, 150, 310, 660, **1000**, 400, 840. The one that crosses is **995**.

5 340 → 300 · 470 → 500 · 650 → 700 · 812 → 800 · 250 → 300.

Digit rule: 400, 400, 700, 200, 600, 1000, 100, 600.

465 rounds to **470** to the nearest ten and **500** to the nearest hundred. Both are right.

6 By 200s: 200, 400, 600, 800, 1000. By 50s: 500, 550 ... 1000. Backwards: 1000, 900 ... 300.

750 is only in the 50s count. 400 is in all three. 300 is in the 50s and 100s. 1000 is in all three.

Jumps from 0 to 1000: **10** in 100s · **5** in 200s · **20** in 50s · **2** in 500s.

7 A **rocket**. Sky is pale blue, body deep red, window pale, flame orange. Every fact is from the 2, 5 or 10 times table.

8 Triangles: 5×4=20, 4×5=20, 20÷5=4, 20÷4=5. Then 2×9=18, 9×2=18, 18÷2=9, 18÷9=2. Then 10×7=70, 7×10=70, 70÷10=7, 70÷7=10.

Divide facts: 8, 5, 3, 6, 8, 10, 10, 9, 9, 7, 3, 6.

Missing: 7, 30, 8, 5, 7, 2, 40, 10.

9 Arrays: 2×6 and 6×2 = 12 · 5×4 and 4×5 = 20 · 2×7 and 7×2 = 14 · 9×3 and 3×9 = 27.

Shaded: 28, 36, 27.

Twenty-four: 1×24, 2×12, 3×8, 4×6 (or their turned-round versions).

23 makes only one array (1×23) because 23 is a prime number.

10 70 crayons · 7 apples · 48 chairs · 5 full bags with 2 left over.

Fractions: 6 halves = **3** · 8 quarters = **2** · 9 thirds = **3**. The tricky one: 5 halves = **2½**.

Stickers: 4×10 = 40, then 40 – 7 = **33**.

11 540, 580, 320, 349, 500, 400.

Take away: 400, 330, 420, 500, 750, **501**.

700 – 199: taking 200 removes one too many, so giving one back makes the answer bigger.

Estimates: 400+200 = 600 (real 602) · 600+100 = 700 (real 787).

12 377 · 484 · 731 · 443 · 423 · 903 · 1000. The one needing **no carrying** is **145 + 232**.

13 233 · 324 · 363 · 646. Past a zero: 500 – 246 = **254** · 1000 – 375 = **625**.

Spot the mistake: 634 – 271 was done as 443 — they took the smaller digit from the larger in the tens instead of borrowing. Correct answer **363**. And 503 – 148 was done as 445 — the zero was mishandled. Correct answer **355**.

14 348 + 175 = 523, then – 62 = **461**.

127 + 145 = 272, then 300 – 272 = **28**.

250 – 85 = 165, then + 120 = **285**.

236 + 148 = 384, then 500 – 384 = **116**.

15 3 · 3 · 3 · 2½ · 2½ · 3½.

The two shaded cakes are the same size, so **1/3 = 2/6**.

20 cookies between 3: **6** whole each, 2 left over, so **6⅔** each.

16 > · > · < · < · > · >

Order: ½, ⅓, ⅙, ⅛, ⅒.

Count the pieces: ¾, ⅔, ⅖, ⅘, ⅙, 1 whole.

One more piece completes a whole for **¾, ⅔, ⅖ and ⅘** — all of them except ⅙, which needs six more eighths.

A note on sheet 16. If only one thing from this book is worth re-reading, it is the fraction wall. A bigger bottom number means a *smaller* piece, and children who never quite absorb that carry the confusion for years. It is worth checking again in a month.



Answers — Algebra and Data, sheets 17 to 27

17 Table of values: 1→4, 2→6, 3→8, 4→10, 5→12, 6→14. Each new table adds **2** chairs, because joining two tables hides one edge on each.

10 tables → **22** chairs · 20 tables → **42** chairs · 16 chairs → **7** tables.

Patterns: 11, 13 (add 2) · 64 (double) · 40, 25 (take 15) · 300, 350 (add 50) · 700, 600 (take 100) · 325, 350 (add 25).

18 Extra dots at (3,8), (4,10), (5,12). They make a **straight line**.

Chains: 8, 14, 20, 26, 32 · 500, 450, 400, 350, 300 · 3, 6, 12, 24, 48 · 1000, 800, 600, 400, 200.

Missing from the middle: 40 and 60 · 130 and 160 · 800 and 600.

The invented pattern is open — anything that passes 500 and follows its own stated rule is right.

19 $n = 8, 14, 8, 18, 8, 35$.

$a = 6$: 16 and 30. $b = 20$: 10 and 40.

Chairs: 4, 6, 12, 18, 22.

Pencils: **p** is how many pencils you buy; **3** is the cost of one pencil, which never changes. $p = 4 \rightarrow \$12$. Cost $\$21 \rightarrow p = 7$.

20 Balances: 10, 5, 6, 150, 8, 5.

True or not: true, true, true, true, **FALSE** (14 is not 15), true, true, **FALSE** (20 is not 16).

Bigger numbers: 450, 650, 750, 325.

The make-it-balance box is open — e.g. $12 = 3 \times 4$, or $12 = 2 \times 6$.

21 The traced program ends on the **star**, facing **west**.

The loop draws a **square** and finishes exactly where it started, facing the same way.

FORWARD 5 instead of 3 → the same square but bigger. REPEAT **3** instead of 4 → only three sides get drawn, so the shape never closes.

The bug: the **TURN LEFT** is **missing**. Instead of a square the robot goes 24 squares in one straight line, straight off the grid.

22 Even only: 2, 4, 6, 8, 12, 14, 16, 18. Counts by 5 only: 5, 15. **Both** (the middle):

10 and 20. Neither: 1, 3, 7, 9, 11, 13, 17, 19.

Counts: $8 + 2 + 2 + 8 = 20$. The Carroll diagram holds exactly the same four groups.

The tree has **8** tips. A small blue circle goes down curved → small → blue.

23 apple **10**, banana **6**, orange **4**, pear **4**, total **24**.

Most common: apple. Least common: **orange and pear are tied** on 4 — a tie is a perfectly good answer.

6 more apples than pears. Apples and bananas together: 16.

Words or numbers: W, N, W, N, W, N.

24 Squares needed: 4, 7, 3, 5, 6. Room 2 needed 7 because $35 \div 5 = 7$.

Minutes: Monday 30, Tuesday 25, Wednesday 40, Thursday 15, Friday 45.

The half bars are on **Tuesday, Thursday and Friday**, and each is worth **5** minutes.

Room 2 read most. 20 more than Room 3. Friday had most reading. Week total **155** minutes.

With a key of 10: Room 2 needs **3½** squares, Room 3 needs **1½**, and the graph gets **smaller**.

25 Dogs are most common. 10 more dogs than birds. 32 pets altogether.

The difference **looks** bigger in Graph A, but there is no real difference — both graphs show **12** dogs.

Scales for 5, 20, 45, 30, 15: in 1s you would need 45 lines, in 5s only 9, in 50s just 1. **Fives** is the sensible choice.

26 The towers level off at **4**.

Means: 4, 6, 25, 5, 5. Modes: 3, 8, 10. The fruit mode from sheet 23 was **apple**.

Books: total 25, 5 children, mean **5**, mode **4**. **Nobody** read exactly 5 — the mean is a fair share, not a real score.

Working backwards: 3 towers with mean 5 means 15 blocks in total, so the third tower is **8**.

27 Spinners in order: **certain, equally likely, likely, unlikely, impossible**.

Everyday: certain · impossible · equally likely · likely · as good as impossible · the dog one depends on where you live, so any sensible answer with a reason is right.

Marbles: red is likely, blue is unlikely, green is impossible. For equally likely you need **5 red and 5 blue**.

Twenty coin flips almost never give exactly 10 and 10, and that is normal.

Class A's mode is **apple**, Class B's is **crackers**. Neither class is wrong — they are different groups of people.

A note on sheet 21. If the robot ends up somewhere unexpected, work through the program one line at a time with a finger rather than re-reading it. Nearly every wrong answer comes from a turn being applied as a move, or from turning the wrong way — and both are obvious the moment you go line by line.



Answers — Spatial Sense, Money and Challenge, sheets 28 to 42

28 cube 6 faces, 12 edges, 8 vertices · rectangular prism 6, 12, 8 · triangular prism 5, 9, 6 · square pyramid 5, 8, 5 · triangular pyramid 4, 6, 4.
Cylinder: 2 flat faces plus a curved surface, and **no vertices**. Cone: 1 flat face plus a curved surface, and exactly **1 vertex**.

Both curved solids roll, because a curved surface has no flat side to stop it — though the cone rolls round in a circle rather than straight.

Euler: faces + vertices – edges = **2** every time.

29 cube 6 squares · rectangular prism 6 rectangles · square pyramid 1 square + 4 triangles · triangular prism 2 triangles + 3 rectangles · cylinder 2 circles + 1 curved piece.

Nets **A and B fold into a cube**. C and D do not — when you fold them two faces land on top of each other and a hole is left somewhere else.

30 Pairs **A and C** are congruent. B is two squares of different sizes; D has the same length but different heights.

A cube has all **6** faces congruent. A cereal box has **3** pairs. On a triangular prism the two **triangular ends** are congruent.

All four corners of a square are congruent, and all twelve edges of a cube are congruent — but a cereal box's edges are **not** all the same.

The tower: **2** rectangular prisms, **1** cylinder, **1** cone, and **no** cubes.

31 Route A → the **Park**. Route B → the **School**. Route C → the **Shop**. Route D → the **Pool**.

A half turn at the Park followed by forward 2 puts you on an empty square **two squares east of Home**.

The closest two places are the **Library and the Park**. There are many different routes from Home to School.

32 Sensible units: cm (or mm) · m · km · mm · m · mm.
Lines: 3.5 cm = **35** mm · 7.2 cm = **72** mm · 1.8 cm = **18** mm.
Swaps: 10, 100, 1000, 40, 300, 2000, 5, 2.

33 Rectangles: **20, 22, 20, 22** cm. Triangle: **18** cm. L-shape: **28** cm.
The 8 by 6 rectangle also has a perimeter of **28** cm — exactly the same as the L. Cutting the corner out removes some edge and adds the same amount back.

34 Missing sides: **4** cm · **4** cm · **6** cm · **5** cm.
Rectangles with perimeter 16: 7&1, 6&2, 5&3, and **4&4** — that last one is the square.
The drawn shapes are open: any shape whose edge counts to 12 or 16 units is correct.
Garden: **22** m of fencing, costing **\$66**. With a 1 m gate you need only **21** m.

35 Tidy squares: **20**. The circles leave **gaps**, so counting them gives an answer that is **too small**. The overlapping squares count some space **twice**, so that answer is **too big**.

All three shapes have an area of **12** squares, even though the long thin one looks nothing like the fat one.

36 Rectangles: **12, 10, 24** cm². Counting and multiplying give the same answer.

Curved shapes: the oval is about **19** cm² and the circle about **28** cm².

Anything within a square or two of those is a good estimate — curves genuinely do not divide into whole squares.

Same area, different perimeter: 1×12 → **26** cm · 2×6 → **16** cm · 3×4 → **14** cm.

The **3 by 4** needs the least fencing.

Units: cm², m², cm², m², cm².

37 **C** is the right angle. **B and E** are smaller; **A and D** are bigger.

Order, smallest opening first: **E, B, C, A, D**.

Wedges: a right angle holds **3**, angle A holds **4**, angle D holds **5**.

The door, the page and the wall corner are right angles. The scissors and elbow can be any angle at all.

38 First balance: the **apple** is heavier. Second: the **shoe** is heavier. Third: the two are **equal**.

Reasoning: yes, the apple is heavier than the plum. The **plum** is lightest.

Order: apple, pear, plum.

The weighing tables are open. In the last box the **beans** number is bigger, because a lighter unit means you need more of them.

39 Clocks: **3:00, 7:15, 9:30, 11:45, 2:20, 6:50**.

Matching: the four clocks are 4:30, 8:15, 12:00 and 5:45, and the digital times are printed in a different order.

Elapsed: **45 minutes · 1 hour · 30 minutes · 1 hour 30 minutes**.

40 Whole dollars: **\$3, \$8, \$4, \$5**. Under a dollar: **35¢, 60¢, 15¢, 75¢**.

Counting up from 40¢: for example 40 → 50 → 75 → 100, handing over a dime and two quarters. Other routes are equally right — the total is always **60¢**.

Estimates: **\$4 + \$9 = \$13 · \$7 + \$2 + \$5 = \$14** · change from \$20 is about **\$6**.

41 Magic square: top row 2, 7, 6 · middle row 9, 5, 1 · bottom row 4, 3, 8.

Mystery number: 630. It is the only one that fits all four clues.

Garden: 4 m by 6 m — $4 \times 6 = 24$ and $2 \times (4 + 6) = 20$.

Five coins: 2 quarters, 1 dime and 2 nickels. That is the only way.

Handshakes: 4 people give **6** handshakes and 5 people give **10**. The jumps go up by 3, then 4 — the rule itself keeps changing.

42 The games have no fixed answers. Race to 1000 rewards saving small numbers for the end.

If you only go back to a few sheets

Forty-two sheets is a lot to revisit. If some of it needs a second pass, these five carry the most weight for the rest of primary school:

Sheet 12 — column adding explained with blocks. The expectation is to *understand* the algorithm, not just run it.

Sheet 16 — the fraction wall. A bigger bottom number means a smaller piece.

Sheet 20 — the equals sign as a balance, not an arrow.

Sheet 26 — the mean as levelling towers, before any adding and dividing.

Sheet 36 — area and perimeter side by side, so they stop getting muddled.

Everything else in this book either rests on those five or is comfortably re-learnable later. And a sheet done twice, months apart, is worth more than two sheets done once.