MathsHUBS Resources

National Centre for Excellence in the Teaching of Mathematics

Mastery Professional Development

Number, Addition and Subtraction

1.26 Composition and calculation: multiples of 1,000 up to 1,000,000

Teacher guide | Year 5

Teaching point 1:

Understanding of numbers composed of hundred thousands, ten thousands and one thousands can be supported by making links to numbers composed of hundreds, tens and ones.

Teaching point 2:

Multiples of 1,000 up to 1,000,000 can be placed in the linear number system by drawing on knowledge of the place of numbers up to 1,000 in the linear number system.

Teaching point 3:

Numbers can be ordered and compared using knowledge of their composition and of their place in the linear number system.

Teaching point 4:

Calculation approaches for numbers up to 1,000 can be applied to multiples of 1,000 up to 1,000,000.

Teaching point 5:

Numbers can be rounded to simplify calculations or to indicate approximate sizes.

Teaching point 6:

Known patterns can be used to divide 10,000 and 100,000 into two, four and five equal parts. These units are commonly used in graphing and measures.

Summer 2018 pilot

Overview of learning

In this segment children will:

- extend their knowledge of the linear number system to include multiples of 1,000 up to 1,000,000
- develop an understanding of how the numbers 10,000 and 100,000 can be decomposed in various useful ways by exploring additive and multiplicative composition
- order and compare multiples of 1,000
- apply known calculation approaches to multiples of 1,000 up to 1,000,000
- develop their understanding of rounding to simplify calculations or to indicate approximate sizes.

This segment builds on children's knowledge from previous segments, in particular:

- *1.17 Composition and calculation: 100 and bridging 100*
- *1.18 Composition and calculation: three-digit numbers*
- *1.19 Securing mental strategies: calculation up to 999*
- *1.22 Composition and calculation: 1,000 and four-digit numbers.*

One of the significant aspects of the number system is that patterns that apply within one unit can be extended to other units. This is one of the reasons that, through these materials, so much emphasis has been put on securing key concepts and facts for smaller numbers as each increasingly large number set is met.

The move from four-digit numbers to five-, six- and seven-digit numbers can be a significant one for children. By now, though, they have extensive knowledge of hundreds, tens and ones, which gives a very solid foundation for understanding larger numbers. The focus of this segment is on making repeated and explicit links between what they know about numbers composed of hundreds, tens and ones, and what there is to know about numbers composed of hundred, ten and one *thousands*. For example, if we know that *345 > 123*, then we know that *345,000 > 123,000*. If we know that *855 – 849 = 6*, then we know that *855,000 – 849,000 = 6,000*. If we know that the midpoint of 600 and 700 is 650, then we know that the midpoint of 600,00 and 700,00 is 650,000. The idea of *unitising* has been met throughout the materials, and again here it is central to learning about this extension of the number system. The children are applying their knowledge to new units, building up in units of one thousand rather than of one.

So that attention can be concentrated on building secure foundations within five- and six-digit numbers (and the seven-digit number 1,000,000) this segment focuses exclusively on five- and six-digit numbers that are multiples of 1,000 (e.g. 15,000, 73,000, 342,000, 900,000, etc.). Five- and six-digit numbers that are *not* multiples of 1,000 (e.g. 345,820) are covered in segment *1.30 Composition and calculation: numbers up to 10,000,000.*

The segment opens by introducing the multiplicative composition of the numbers 10,000 and 100,000 and giving the children a sense of the size of these units. Some children have the misconception that 'millions' is the next column to the left of 'one thousands', so plenty of verbalising and seeing representations of 'ten thousands' and 'hundred thousands' is needed. In a similar vein to other segments that extend the number system, both cardinal and ordinal aspects of numbers to 1,000,000 are focused on. Once these have been understood, the segment moves on to focusing on comparison.

Teaching point 4 focuses on calculating with multiples of 1,000. During this teaching point, it is strongly recommended that segments *1.18* and *1.19* are read alongside this segment, as these provide a very comprehensive approach to calculating with three-digit numbers (segment *1.18*) and mental strategies for calculation up to 999 (segment *1.19*), all of which can then be applied here.

This segment finishes with rounding and the application of five- and six-digit numbers to graphing and measures.

Through this segment, once children have got the key idea of unitising from *Teaching point 1*, you may find they can move quite quickly through the mathematics in the subsequent teaching points. However, do take plenty of opportunities where you can for them to practise the application of what they have learnt, solving mathematics problems (contextual and non-contextual) involving these larger numbers.

An explanation of the structure of these materials, with guidance on how teachers can use them, is contained in this NCETM podcast: www.ncetm.org.uk/primarympdpodcast. The main message in the podcast is that the materials are principally for professional development purposes. They demonstrate how understanding of concepts can be built through small coherent steps and the application of mathematical representations. Unlike a textbook scheme they are not designed to be directly lifted and used as teaching materials. The materials can support teachers to develop their subject and pedagogical knowledge and so help to improve mathematics teaching in combination with other high-quality resources, such as textbooks.

Teaching point 1:

Understanding of numbers composed of hundred thousands, ten thousands and one thousands can be supported by making links to numbers composed of hundreds, tens and ones.

Steps in learning

	Guidance	**Representations**

1:1

Start this unit by counting up in thousands to 10,000, supported by representations of groups of 1,000, for example, boxes containing jigsaw pieces.

In earlier segments, children learnt that:

- ten tens are called *'one hundred'*
- ten hundreds are called *'one thousand'*.

This time, ten thousands don't have a different name. They are simply called *'ten thousand'*. This will make ten thousand easier to deal with than the previous two new units the children met.

Counting up in 1,000s:

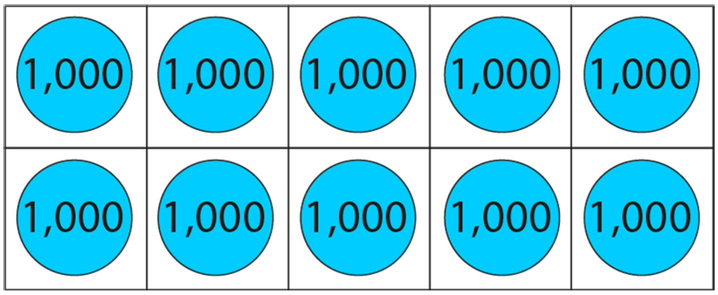
1:2

As a class, look at alternative representations of 10,000 composed from ten thousands. For example, a tens frame containing ten 1,000 place-value counters or a bar model.

In order to embed the connection between 1,000 and 10,000, as you show the children these representations, repeat the following generalised statement using the *'I say, you say, we all say'* format: ***'Ten one thousands make ten thousand.'***

Next, re-present the bar model with each unit of 1,000 broken up into ten one hundreds. Make sure that children notice that the sum of each column of one hundreds is 1,000, which matches up with the bar model. Reinforce this by repeating the generalised statement: ***'One hundred hundreds make ten thousand.'***

Tens frame and place-value counters:



Bar model:

10,000									
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

One hundred hundreds in 10,000:

10,000									
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100

1:3

At this stage, it is useful for children to have some number sense of 10,000 using people and measures, as well as pictorial representations. For example:

- *'How much space do ten thousand people need? Mansfield Town's football ground has a capacity of ten thousand people.' (approximately)*
- *'Ten thousand is the number of steps that some people recommend we take each day.'*
- *'When you are twenty-seven years old, you will have lived for ten thousand days.'*
- *'Ten thousand metres is a race run in athletics competitions. It takes Mo Farah just under half an hour to run ten thousand metres.'*
- *'One square metre is ten thousand square centimetres (cm^2) because one hundred centimetres multiplied by one hundred centimetres is equal to ten thousand square centimetres.'*

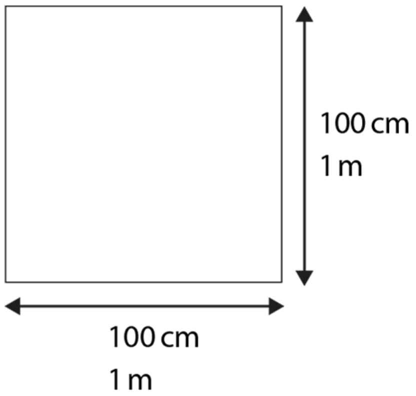
For the final example above, pieces of 1 cm × 1 cm square paper could be put together to make one square metre with ten thousand 1 cm^2 squares inside.

Make connections with other measurement units using pictorial or concrete examples, as shown below. It is useful here to have examples of:

- 1 ml (recall that a 1 cm cube holds 1 ml of water)
- a 1 g plastic measuring disc
- a ruler marked in centimetres.

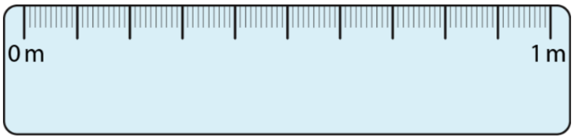
You can also make a comparison between what £10,000 buys (for example, a small car) compared with what £1,000 buys (for example, a large sofa).

Number sense of 10,000 – measures:



$$100\,\text{cm} \times 100\,\text{cm} = 10{,}000\,\text{cm}^2$$

$$1\,\text{m} \times 1\,\text{m} = 1\,\text{m}^2$$

	1 litre × 10 bottles = 10 litres = 10,000 ml
	1 kg × 10 bags = 10 kg = 10,000 g
	1 m × 100 = 100 m = 10,000 cm

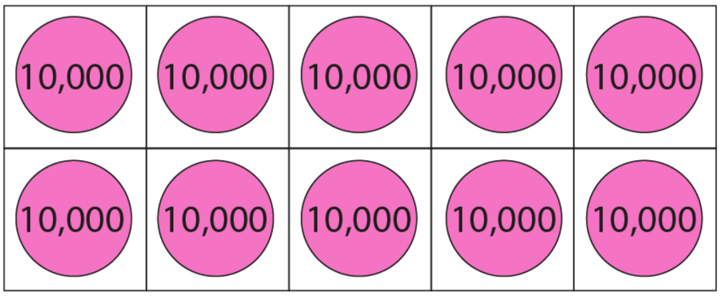
1:4

Now present a tens frame with ten 10,000 counters in it and the corresponding bar model, as shown below. As a class, count up in 10,000s to 100,000, tapping each representation of 10,000 as you go.

Children should recognise the connections between 1,000, 10,000 and 100,000. As in step *1:2*, repeat a generalised statement: ***'Ten ten thousands make one hundred thousand.'***

Next, re-present the bar model with each unit of 10,000 broken up into ten one thousands. Children should notice that the sum of each column of one thousands is 10,000, which matches up with the bar model. Reinforce this by repeating the generalised statement: ***'One hundred one thousands make one hundred thousand.'***

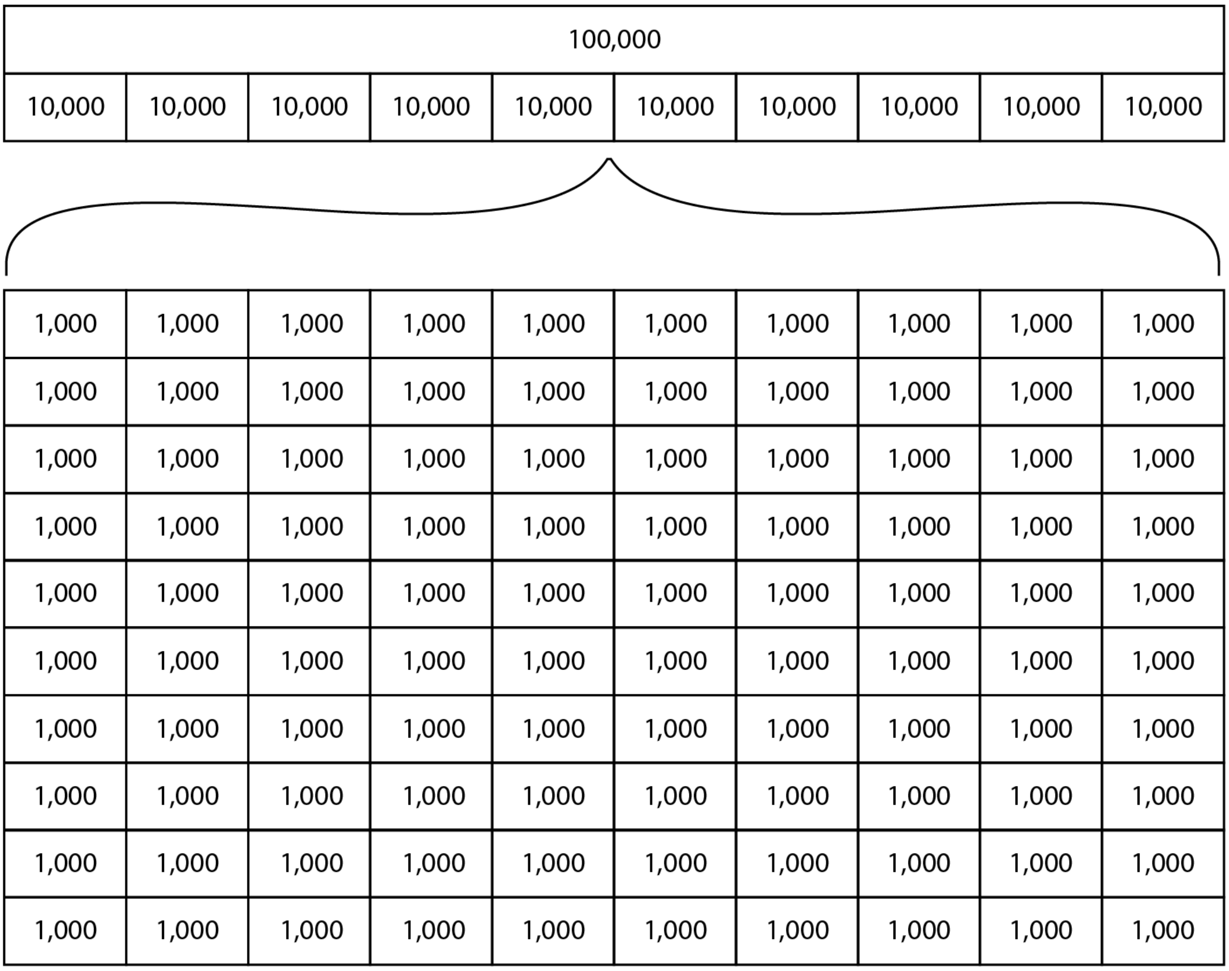
Tens frame and place-value counters:



Bar model:

<table>
<tr><td colspan="10">100,000</td></tr>
<tr><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td></tr>
</table>

One hundred thousands in 100,000:



<table>
<tr><td colspan="10">100,000</td></tr>
<tr><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td></tr>
</table>

1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

1:5

As for 10,000 in step *1:3*, it is useful for children to have some number sense of 100,000 using people and measures, as well as pictorial representations.

For example, in the same way you prompted children to imagine the space needed for 10,000 people in step *1:3*, you can discuss that:

- *'One hundred thousand people is the approximate capacity of the largest football ground in Europe, Camp Nou in Barcelona.'*
- *'One hundred thousand is about the number of times your heart beats in a day.'*
- *'One hundred thousand is approximately the number of words in the book* Harry Potter and the Prisoner of Azkaban.*'*

1:6

Having now met the units 10,000 and 100,000, unpick the structure behind the writing of these numbers and extend up to the writing of 1,000,000. Look at these numbers, plus whole numbers they have met previously, written on a place-value chart.

Explain that when the place-value chart is removed, it is harder to read the numbers, so commas are inserted in numbers greater than 999 to support this. Commas separate the thousands from the ones, and the millions from the thousands.

Practise reading and writing different powers of ten, for example:

- show the children numerals (for example, 10,000, 100, 1,000,000), and ask them to read out the numbers
- say a number (for example, *'ten thousand'*) and ask the children to write it in digits on their whiteboards.

Place-value chart:

Millions			**Thousands**			**Ones**		
100s	**10s**	**1s**	**100s**	**10s**	**1s**	**100s**	**10s**	**1s**
								1
							1	0
						1	0	0
					1	0	0	0
				1	0	0	0	0
			1	0	0	0	0	0
		1	0	0	0	0	0	0

Reading and writing numbers:

1	one
10	ten
100	one hundred
1,000	one thousand
10,000	ten thousand
100,000	one hundred thousand
1,000,000	one million

1:7 Look now at the Gattegno chart, which the children are already familiar with, to show that each power of ten is ten times larger than the previous one. It is helpful for the children to have copies of the Gattegno chart that they can use in pairs on their tables.

Start by looking at the left-hand column, with the powers of ten. (A power of ten is obtained by multiplying or dividing one by ten repeatedly, for example:

$1 \times 10 \times 10 = 10^2 = 100$

or, more simply,

$10 \times 10 = 10^2 = 100$

Similarly,

$10 \times 10 \times 10 = 10^3 = 1{,}000$

also,

$1 \div 10 = 10^{-1} = 0.1$

and

$1 \div 10 \div 10 = 10^{-2} = 0.01$

and so on.)

With the charts in front of them, ask the children questions such as:

- *'Which number is one hundred times bigger than one thousand?'*
- *'Which number do you get if you divide one hundred thousand by ten?'*

You can include all the powers of ten in your questioning, but particularly focus on 1,000, 10,000 and 100,000.

Gattegno chart:

10 times larger (× 10)

10 times smaller (÷ 10)

1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

1:8 Once children are comfortable with powers of ten, look along the new rows of the Gattegno chart from step *1:7*, focusing on ten thousands and hundred thousands:

- Count in steps of 10,000 and 100,000 (*'Ten thousand, twenty thousand, thirty thousand…'*), asking the children to point to each number as they say it.
- Point to a number (e.g. 40,000) and ask the children to say it.
- Say a number (e.g. 300,000) and ask the children point to it. During this activity, also make sure that the children can write the number on their mini whiteboards, moving to doing this without the chart as support.
- Then work up and down the columns asking, for example, *'Which number is ten times bigger than thirty thousand?'*

1:9 Use the Gattegno chart to illustrate how five- and six-digit numbers are formed. First, circle a number from each of the bottom three rows (e.g. 400, 80 and 5, as shown below). The children will confidently be able to combine these:

$400 + 80 + 5 = 485$

Now circle numbers on the corresponding multiples of 1,000 in the next three rows up (here, 400,000, 80,000 and 5,000) and talk through the addition calculation:

$400{,}000 + 80{,}000 + 5{,}000$

By unitising, make the explicit link between these two calculations, as shown below.

Repeat this sequence of equations until you can just circle a number on each of the three thousands rows (hundred thousands, ten thousands, one thousands) and the children can confidently write an equation to express what the total of the three numbers is.

Give opportunities to recognise numbers that have a zero in one of the thousands rows, as these can sometimes cause confusion, e.g.:

700 + 20 = 720

and

700,000 + 20,000 = 720,000

300 + 6 = 306

and

300,000 + 6,000 = 306,000

Provide an opportunity for children to practise this skill until they are confident.

Addition calculations:

1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

400 + 80 + 5 = ☐

400 thousand + 80 thousand + 5 thousand = ☐ thousand

400,000 + 80,000 + 5,000 = ☐

1:10 Present to the children an alternative representation of the multiples of 1,000, that of place-value counters:

- Show just 100,000 counters, 10,000 counters or 1,000 counters, and ask the children to say or write the total amount.
- Say an amount that can be made with one value of counter (for example, *'forty thousand'*) and ask the children to show the amount with place-value counters.
- Point to a number in any of the thousands rows of the Gattegno chart and ask the children to make it with place-value counters.

Then combine 100,000 counters, 10,000 counters and 1,000 counters, and show the children how to write these numbers. Equally, write a multiple of 1,000 (e.g. 763,000) and ask the children to show it with counters. As in the previous step, include numbers that have a zero in place of one of the thousands digits (e.g. 560,000).

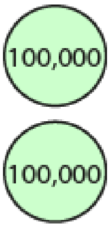
Make sure that there is variation in how the counters are presented, so that they are not always aligned in place-value order.

Provide an opportunity for children to practise this skill until they are confident.

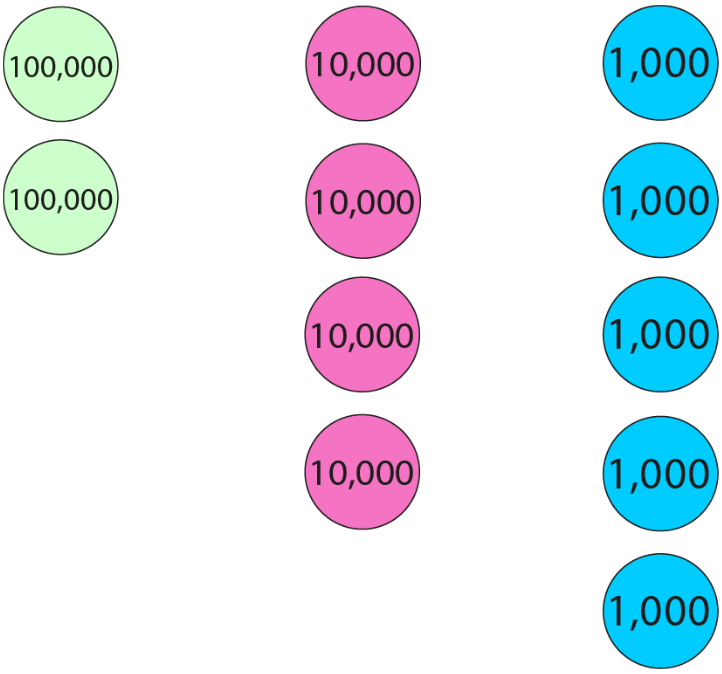
Place-value counters:

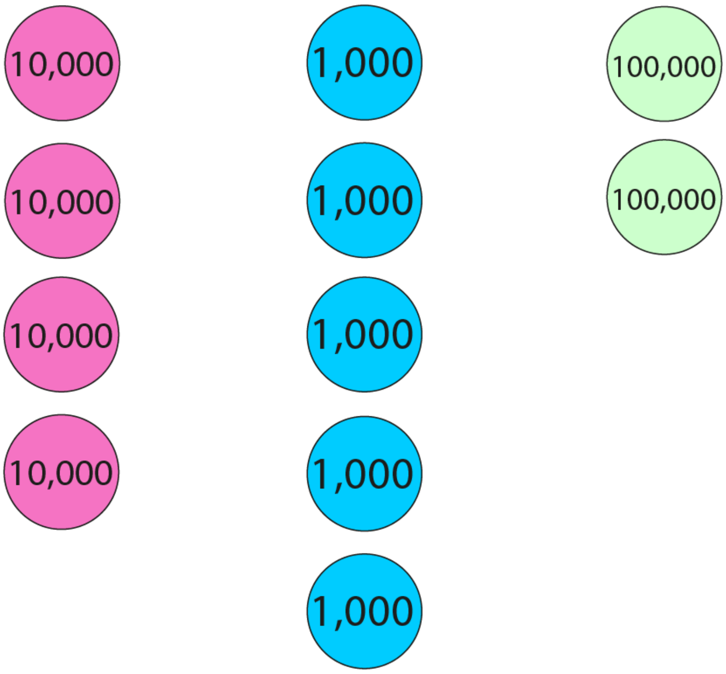
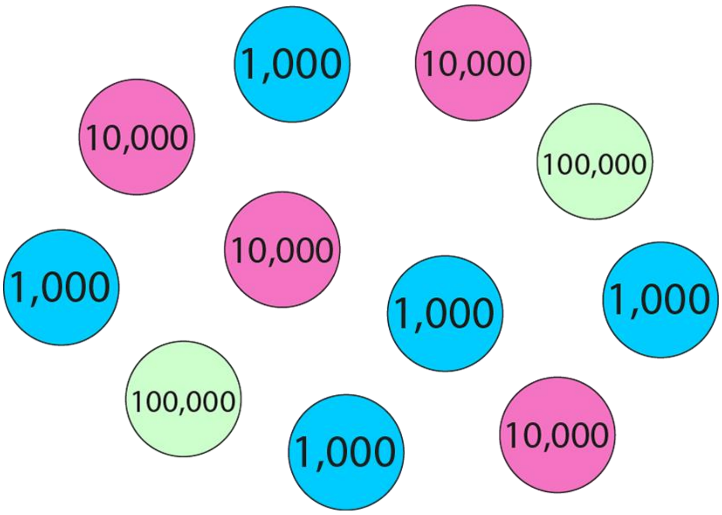
'Say or write the number shown by the counters.'

- Counters of the same value



- Counters of different values, grouped by value and in place-value order



	- Counters of different values, grouped by value but not in place-value order  - Counters of different values, randomly arranged 
1:11	Now look at examples of four-, five-, and six- digit multiples of 1,000 that don't have commas to separate the thousands. Children need to be confident reading numbers that have a space as a thousands separator, in place of a comma. They also need to be able to put a comma in numbers where no separation is provided at all, such as on a car mileometer or a gas meter. Now that children have a good understanding of numbers up to 1,000,000 they should be confident in doing this. However, watch out for children who count three places from the left when inserting the comma, for example, writing 34000 as 340,00. This error will only show up in four- and five-digit numbers; for six-digit numbers, children may still be making this conceptual error, but you won't be able to see it.

Space as a thousands separator:

4 000 73 000 189 000

Numbers with no separators:

1:12 Children have already practised their developing skills through this teaching point. Finally, provide varied practice integrating different ways of thinking about the composition of multiples of 1,000, such as the examples shown below, so that you are sure children are developing deep understanding of this.

Varied practice:

'Fill in the missing numbers.'

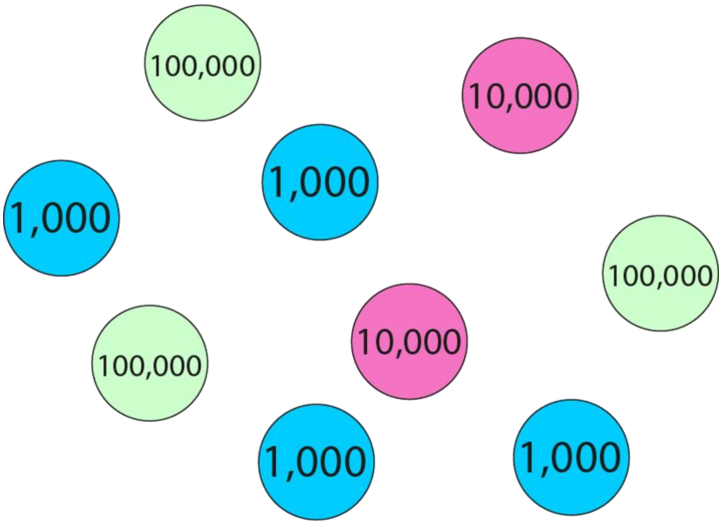
10,000 + 10,000 + 100,000 + 100,000 + 10,000 = ☐

352,000 = ☐ × 100,000 + ☐ × 10,000 + ☐ × 1,000

472,000 = 72,000 + ☐

813,000 = ☐ + 803,000

'Look at these place-value counters. Draw this number on a Gattegno chart.
Write an addition equation to show the composition of the numbers.'



Dòng nǎo jīn:

'Complete this equation in many different ways.'

$$352{,}000 = \boxed{} \times 100{,}000 + \boxed{} \times 10{,}000 + \boxed{} \times 1{,}000$$

(e.g. 2 × 100,000 + 15 × 10,000 + 2 × 1,000

or

0 × 100,000 + 0 × 10,000 + 352 × 1,000)

Teaching point 2:

Multiples of 1,000 up to 1,000,000 can be placed in the linear number system by drawing on knowledge of the place of numbers up to 1,000 in the linear number system.

Steps in learning

	Guidance	**Representations**

2:1

Now move on to locating the ordinal position of numbers in the number system and identifying numbers marked on a number line.

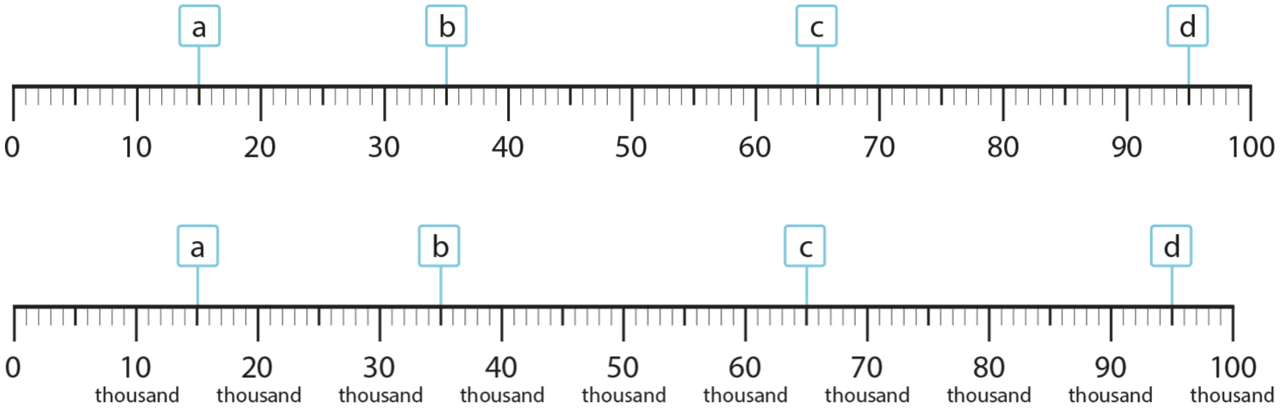
In segment *1.22 Composition and calculation: 1,000 and four-digit numbers*, children unitised to link what they know about three-digit numbers to four-digit numbers. Again in this teaching point, focus on building direct links from children's knowledge of two- and three-digit numbers to five- and six-digit numbers. The aim is to avoid common errors, like marking the midpoint of 10,000 and 20,000 as 10,005 or 10,500.

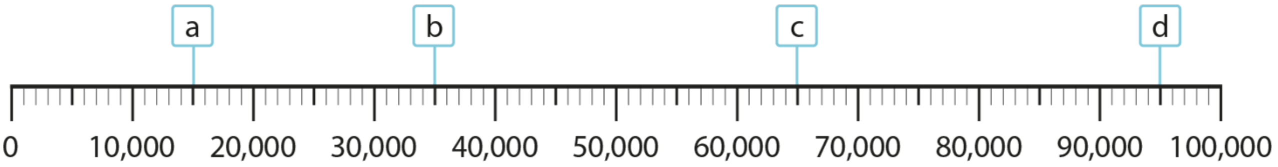
Start by displaying the 0–100 number line, shown below. Identifying the numbers located at the small tick marks is a skill that will be deeply embedded by now. Draw arrows or boxes pointing to some numbers, as below, and ask children to explain how they can identify what these are. Once you have checked they can do this confidently, look at the second (unitised) number line shown below. Discuss the value of each of the labelled intervals ('*10 thousand*') and each of the smaller unlabelled intervals ('*1 thousand*'). Explicitly make the link back to the previous number line and ask children to identify the numbers shown by the boxes, using the following stem sentence to structure their answers: ***'The midpoint of ___ and ___ is ___, so the midpoint of ___ thousand and ___ thousand is ___ thousand.'***

Once the children can work with the middle 'unitised' number line and verbally identify the midpoints, introduce the final number line shown below. As a class, count up in 10,000s, pointing to the digits as you go, to reinforce the connection between the three number lines; children should be quite confident counting up in 10,000s from *Teaching point 1*. Ask them to identify the same midpoints marked by the boxes, again linking to the previous two number lines. This time, make sure that the children are able to write the midpoints in numerals (e.g. '*15,000*') as well as say them in words (for example '*fifteen thousand*').

Number lines:

'What are the midpoints shown by a–d?'





- *'The midpoint of ten and twenty is fifteen, so the midpoint of ten thousand and twenty thousand is fifteen thousand.'*
- *'The midpoint of thirty and forty is thirty-five, so the midpoint of thirty thousand and forty thousand is thirty-five thousand.'*

2:2

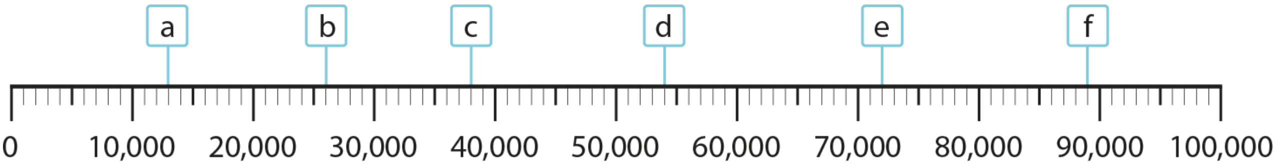
Once children can confidently identify midpoints, move on to identifying other five-digit multiples of 1,000 at marked but unlabelled intervals. Continue to ensure that children can write the points in numerals as well as say them in words.

Next, ask the children to mark given multiples of 1,000 on the 0–100,000 number line. Make links back to the 1–100 and unitised number lines from step *2:1* to scaffold if necessary.

For further practice, you could show five-digit multiples of 1,000 on the Gattegno chart, or using place-value counters, for children to place on the number line. Alternatively, identify five-digit multiples of 1,000 on the number line and ask children to write different expressions or draw place-value counters to represent them.

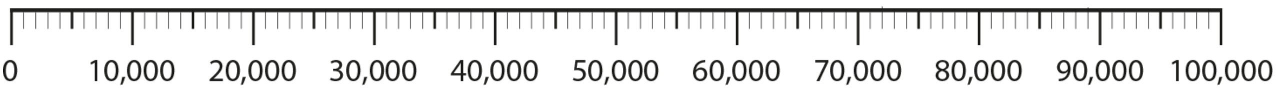
Number lines:

- *'Identify points* a–f *on this number line.'*



- *'Mark the following numbers on the 0–100,000 number line.'*

43,000 12,000 98,000 61,000



Dòng nǎo jīn:

'Mark the totals of the following calculations on the 0–100,000 number line.'

56 × 1000

8,000 + 20,000

3 × 1,000 + 4 × 10,000

1,000 + 10,000 + 10,000 + 10,000 + 1,000 + 10,000

2:3

Repeat the previous two steps for the 0–1,000,000 number line, as shown below, looking at the positioning of six-digit multiples of 1,000. Ask children to:

- identify the interval size between consecutive labelled points (100 for the first number line and 100,000 for the next two number lines)
- identify the interval size between consecutive unlabelled point (ten for the first number line and 10,000 for the next two number lines)
- identify midpoints between consecutive labelled points, first on the 1–1,000 number line (e.g. 450) and then extending this to the unitised hundred thousands line (e.g. 450 thousand) and finally on the 0–1,000,000 number line (e.g. 450,000).

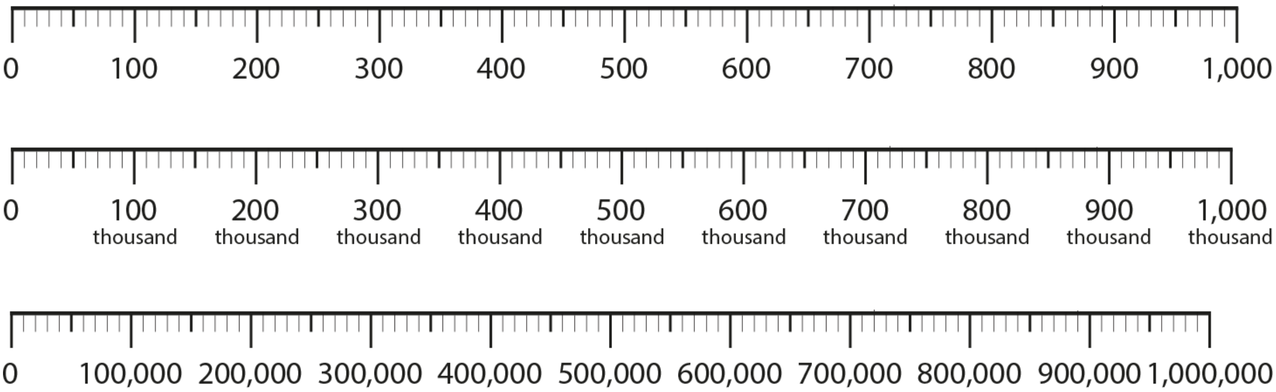
As in step *2:1*, use the following stem sentence to structure children's answers when finding the midpoints: ***'The midpoint of ___ and ___ is ___, so the midpoint of ___ thousand and ___ thousand is ___ thousand.'***

As before, ensure that children are able to write the midpoints in numerals (e.g. *'450,000'*) as well as say them in words (e.g. *'four hundred and fifty thousand'*).

Finally in this step, when children are confident reading the number lines and midpoints, ask them to:

- identify any multiple of 10,000 on the third number line (for example, identify that an arrow is pointing at the number 540,000)
- mark multiples of 10,000 on the third number line (for example, mark the point 890,000).

Number lines:



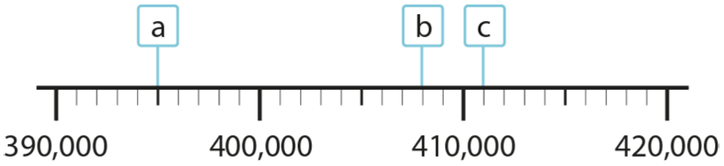
'The midpoint of four hundred and five hundred is four hundred and fifty, so the midpoint of four hundred thousand and five hundred thousand is four hundred and fifty thousand.'

2:4

Progress to looking at segments of number lines between 0 and 1,000,000 with different scales, such as those shown below. Again, give children practice at identifying intermediate values marked by tick marks and completing missing values on number lines and scales.

Identifying the values of intermediate points:

'*'What numbers are shown by* a–c?'

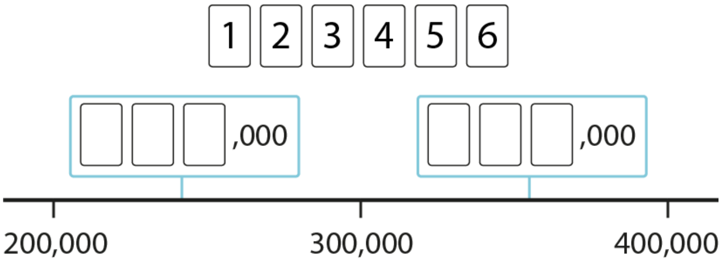


Completing missing values:

'Write in the missing numbers on each number line.'

Dòng nǎo jīn:

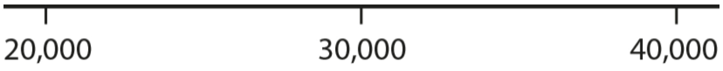
'Use the digit cards 1– 6 to complete the missing values on the number line.'

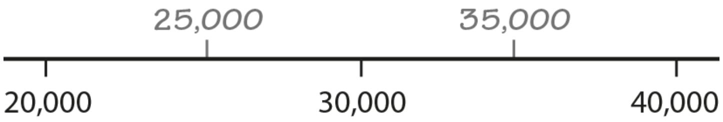


2:5 Now give children experience of estimating the position of numbers on partially completed number lines, as shown below. Prompt them to first mark on the midpoints between the given numbers, as shown below, before making their estimates. You may also present the numbers in words. Again, encourage them to first mark on the relevant midpoint.

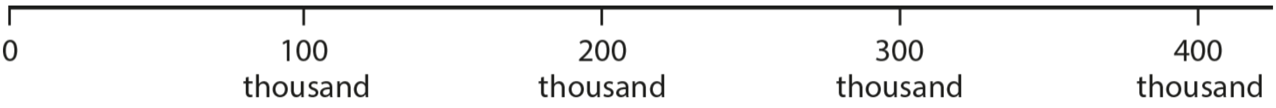
Esitmating the position of numbers:

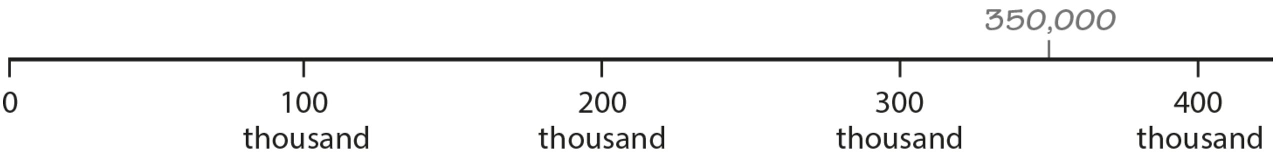
'Estimate where 28,000 will be on the number line.'





'Where will 320,000 be on the number line?'





2:6

Finally, practise counting forwards and backwards in steps of powers of ten from *any* multiple of 1,000 up to 1,000,000. Make sure you include examples that cover potentially difficult points:

- bridging across a boundary (e.g. 394,000, 404, 000, 414,000…)
- numbers with a zero as one of the thousands digits (e.g. 204,000, 304,000, 404,000…)
- sequences that count backwards (e.g. 325,000, 315,000, 305,000…).

Children need opportunities to practise and some may need more scaffolding, in which case go back to unitising, first working with sequences such as '394, 404, 414…', then '394 thousand, 404 thousand, 414 thousand…' and finally '394,000, 404,000, 414,000…'.

To complete this teaching point, give children varied practice by setting problems that draw on their counting, such as those shown below.

Missing-number sequences:

'Fill in the missing numbers.'

6,000	7,000,	8,000			

			19,000	18,000	17,000

75,000	85,000	95,000			

325,000			295,000		275,000

384,000	394,000		414,000		

204,000	304,000		504,000	

	707,000			407,000

Number sequences with reasoning:

'What comes next?'

365,000 + 10,000 = 375,000

375,000 + 10,000 = 385,000

385,000 + 10,000 = 395,000

…

	846,000 – 10,000 = 836,000 836,000 – 10,000 = 826,000 826,000 – 10,000 = 816,000 … Dòng nǎo jīn: *'Demi is counting forwards in steps of 50,000. One of the numbers she says is 175,000. Which of these other numbers will she say?'* 180,000 750,000 225,000 975,000 300,000

Teaching point 3:

Numbers can be ordered and compared using knowledge of their composition and of their place in the linear number system.

Steps in learning

	Guidance	**Representations**
3:1	By now, children should be securing their understanding of five- and six-digit multiples of 1,000, and how they can use their knowledge of hundreds, tens and ones to support this. This teaching point focuses on comparing and ordering these numbers. It links back to two- and three-digit numbers and children's comparison of them in segments *1.9 Composition of numbers: 20–100* and *1.18 Composition and calculation: three-digit numbers*, as well as drawing on their cardinal and ordinal understanding from *Teaching points 1* and *2*. Begin by showing the children that to compare multiples of 1,000 we just need to look at the number of thousands that there are. Take two five-digit multiples of 1,000 to start with (e.g. 54,000 and 58,000). Draw on children's experience of unitising by focusing on the first two digits of each number (here, 54 and 58) and use the stem sentences: - ***'___ is less than ___, so ___ thousand is less than ___ thousand.'*** - ***'___ is greater than ___, so ___ thousand is greater than ___ thousand.'*** Encourage the children to write inequality sentences using the *greater than* and *less than* signs, as shown opposite, to continue making sure they are confident writing the numbers in numerals as well as saying them in words.	Comparing five-digit multiples of 1,000: *'Which is less, 54,000 or 58,000?'* **54,000** (54 thousand) **58,000** (58 thousand) *'Fifty-four is less than fifty-eight, so fifty-four thousand is less than fifty-eight thousand.'* 54 < 58 so 54,000 < 58,000

	If children need support, you can refer back to the place-value counters or numbers lines used in *Teaching points 1* and *2* to show the relative sizes of the five-digit numbers.	
3:2	When children are confident comparing five-digit multiples of 1,000, repeat the process for six-digit multiples of 1,000 (e.g. 820,000 and 690,000), now focusing on the first three digits of each number (here, 820 and 690). Again, use the stem sentences: - ***'___ is less than ___, so ___ thousand is less than ___ thousand.'*** - ***'___ is greater than ___, so ___ thousand is greater than ___ thousand.'***	Comparing six-digit multiples of 1,000: *'Which is greater, 820,000 or 690,000?'* **820,000** (820 thousand) **690,000** (690 thousand) *'Eight hundred and twenty is greater than six hundred and ninety, so eight hundred and twenty thousand is greater than six hundred and ninety thousand.'* 820 > 690 so 820,000 > 690,000
3:3	To complete this teaching point, give children varied practice comparing five- and six-digit multiples of 1,000, including: - numbers with different numbers of digits - comparisons that involve adding parts - comparisons without a thousands separator (comma or space) - ordering sets of numbers. If children struggle with ordering sets of numbers, prompt them to unitise the thousands as they have just been doing when ordering pairs of numbers. Remind them too of the generalised statement they met in segment *1.18 Composition and calculation: three-digit numbers*: ***'To compare three-digit numbers, we need to compare the hundreds digits; if the hundreds digits are the same, we need to compare the tens digits; if the tens digits are the same, we need to compare the ones digits.'***	Comparing five-and six-digit multiples of 1,000: *'Fill in the missing symbols (< or >).'* 294,000 ○ 617,000 75,000 ○ 80,000 548,000 ○ 60,000 548,000 ○ 550,000 99,000 ○ 101,000 534,000 ○ 300,000 + 50,000 + 4,000 43000 ○ 420000 *'Order these numbers from least to greatest.'* 45,000 504,000 450,000 54,000 155,000 4,000

Dòng nǎo jīn:

- *'What is the biggest possible multiple of 100,000 that makes both of these inequalities true?'*

  $723{,}000 > \boxed{} + 30{,}000$

  $723{,}000 > \boxed{} + 20{,}000$

- *'Areeb writes the same multiple of 10,000 into both gaps. What is the smallest multiple of 10,000 that makes this inequality true?'*

  $400{,}000 + \boxed{} > 500{,}000 - \boxed{}$

- *'How many ways can you arrange these digit cards so that the inequality is true?'*

  $\boxed{4}\,\boxed{5}\,\boxed{6}$

  $\boxed{5}\,\boxed{}\,\boxed{8}\,\boxed{0}\,\boxed{0}\,\boxed{0} < \boxed{}\,\boxed{5}\,\boxed{}\,\boxed{0}\,\boxed{0}\,\boxed{0}$

Teaching point 4:

Calculation approaches for numbers up to 1,000 can be applied to multiples of 1,000 up to 1,000,000.

Steps in learning

Guidance

4:1

This teaching point builds on the knowledge of number composition from *Teaching point 1* to look at calculation with multiples of 1,000. Referring to segments *1.18 Composition and calculation: three-digit numbers* and *1.19 Securing mental strategies: calculation up to 999* will support such calculation. This teaching point progresses through:

- addition and subtraction without bridging
- working to boundaries: complements to boundaries and subtraction from boundaries
- mental addition and subtraction across boundaries
- column addition and subtraction across boundaries.

Start with addition by partitioning a six-digit multiple of 1,000 into its hundred thousands, ten thousands and one thousands parts using part–part–part–whole models. As in previous teaching points, use unitising to link back to children's knowledge of three-digit numbers.

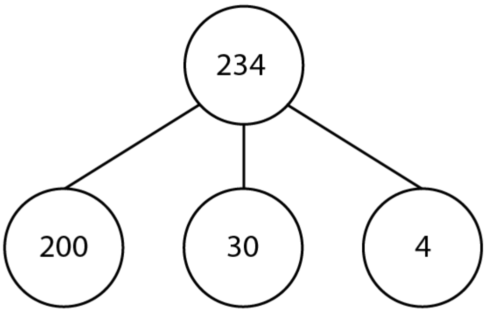
You may also wish to represent the six-digit number using place-value counters.

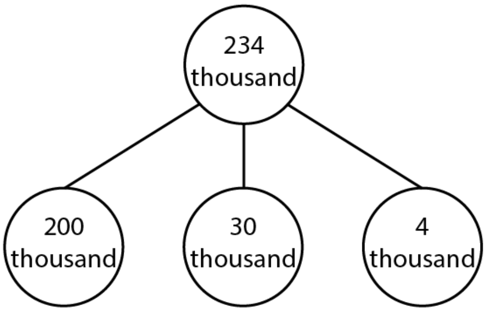
Give the children an opportunity to express the composition in alternative forms, including finding a missing part in equations and part–part–part–whole models with different compositions.

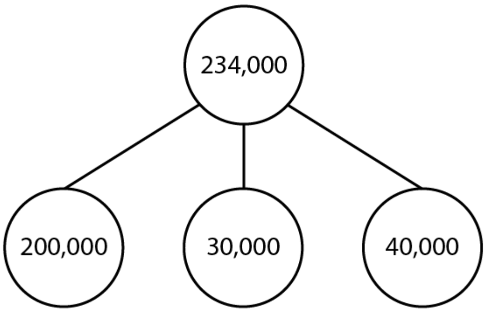
Move on to explore what happens when a part of the number is subtracted. This all builds directly on

Representations

Addition – part–part–part–whole models:







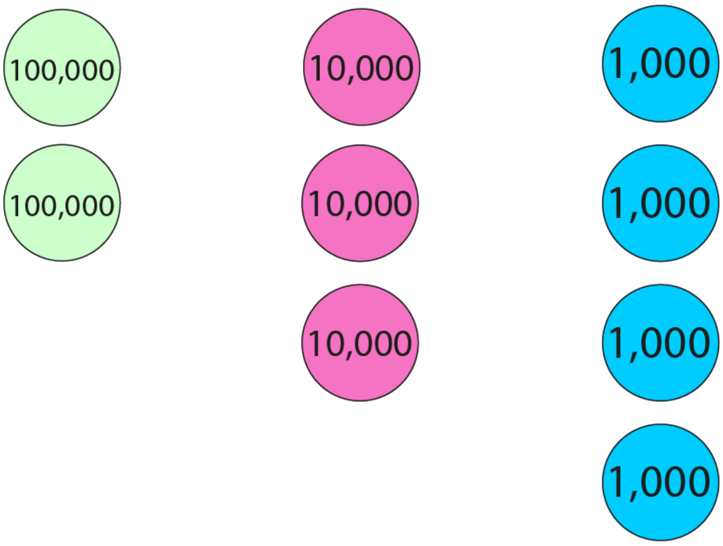
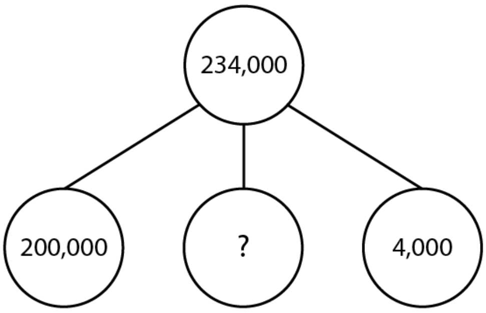
234 = 200 + 30 + 4

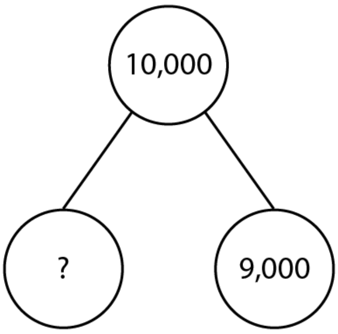
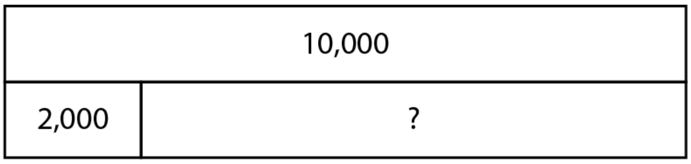
so

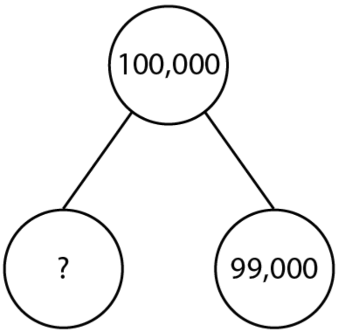
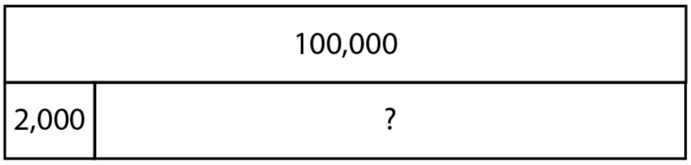
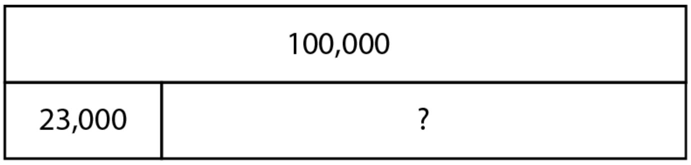
234 thousand = 200 thousand + 30 thousand
+ 4 thousand

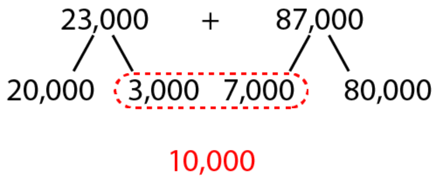
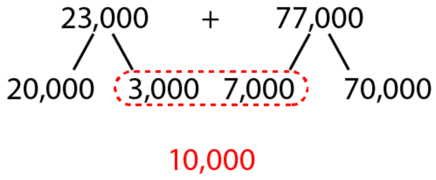
that is

234,000 = 200,000 + 30,000 + 4,000

	concepts that the children have explored in detail before, so keep linking back to their knowledge of three-digit numbers and they should quickly be able to work without the support of concrete resources. Give children a range of similar calculations to practise with different numbers.	Place-value counters:  Addition – missing-number problems: *'Fill in the missing numbers.'* 234,000 = 100,000 + 130,000 + 4,000 $234{,}000 = \boxed{} + 100{,}000 + 100{,}000$ $234{,}000 = 120{,}000 + 4{,}000 + \boxed{}$ 

		Subtraction calculations: *'Fill in the missing numbers.'* 234,000 – 2,000 = ☐ 234 – 2 = ☐ 234,000 – 4,000 = ☐ 234 – 4 = ☐ 234,000 – 20,000 = ☐ 234 – 20 = ☐ 234,000 – 30,000 = ☐ 234 – 30 = ☐ 234,000 – 100,000 = ☐ 234 – 100 = ☐ 234,000 – 200,000 = ☐ 234 – 200 = ☐ Dòng nǎo jīn: *'Find a pair of multiples of 1,000 that complete this equation. And another pair. And another pair…'* 612,000 + ☐ – ☐ = 512,000 *'What is the same about the relationship between each pair of numbers that you chose?'*
4:2	In segment *1.17 Composition and calculation: 100 and bridging 100*, children learnt to find complements to 100. This step follows on fairly easily to 'whole-thousands' complements to 10,000 and 100,000. These could be represented by part–part–whole models (bar model or cherry diagram) initially, but you should be able to remove the representations over quite a short period of time so that children rely on combining their known facts with unitising without this layer of scaffolding. For complements of 100,000, you can give the children some conditions, for example:	Complements to 10,000: - Part–part–whole models  

	- *'One number is a four-digit number, the other number is a five-digit number. What are the possible complements?'* - *'One of the numbers is between seventy thousand and eighty thousand, what are the possible complements?'*	- Unitising 3 + 7 = 10 3,000 + 7,000 = 10,000 - *'I know that three plus seven equals ten.'* - *'So three thousand plus seven thousand equals ten thousand.'* Complements to 100,000: - Part–part–whole models   - Unitising 30 + 70 = 100 30,000 + 70,000 = 100,000 - *'I know that thirty plus seventy equals one hundred.'* - *'So thirty thousand plus seventy thousand equals one hundred thousand.'*
4:3	In segment *1.17 Composition and calculation: 100 and bridging 100,* children looked out for the common error of finding complements to 110 instead of to 100, e.g.: 23 + 87= 100 ✗ rather than 23 + 77 = 100 ✓ Revisit this, extending children's knowledge of bonds to 100 to bonds to 100,000 (still working with multiples of 1,000). Ask children what the likely	Missing-number problems: *'Fill in the missing number. What mistake might someone make?'*  20,000 + 80,000 = 100,000 3,000 + 7,000 = 10,000 100,000 + 10,000 = 110,000

	mistake that someone would make might be. It is useful to explicitly recap on this common error to help children avoid making it themselves and for them to be able to explain the mistake they need to look out for.	 20,000 + 70,000 = 90,000 3,000 + 7,000 = 10,000 90,000 + 10,000 = 100,000  Dòng nǎo jīn: *'Amal says that 100,000 – 23,000 = 87,000* *What mistake has Amal made?* *Find two different ways to help her understand what the correct answer should be.'*
4:4	Provide varied practice for the children on calculations that can be solved mentally. In segment *1.19 Securing mental strategies: calculation up to 999*, children were taught strategies for simplifying mental calculation of three-digit numbers. All of these can be applied here to multiples of 1,000. This might include the examples opposite, but referring back to segment *1.19* will provide further examples both of calculations and teaching approaches.	Mental calculations: *'Fill in the missing numbers.'* • Non-bridging 3,000 + 2,000 = 9,000 – 4,000 = 13,000 + 42,000 = 19,000 – 14,000 = 130,000 + 420,000 = 190,000 – 140,000 =

- Bridging

7,000 + 5,000 = ☐

37,000 + 45,000 = ☐

87,000 + 65,000 = ☐

- Connected calculations

143,000 + 4,000 = ☐

143,000 + 40,000 = ☐

143,000 + 400,000 = ☐

- Doubling

16,000 + 16,000 = ☐

180,000 + 180,000 = ☐

- Subtracting from boundaries/finding a missing part to boundaries

100,000 – 24,000 = ☐

300,000 – 7,000 = ☐

500,000 – 16,000 = ☐

367,000 + ☐ = 400,000

591,000 + ☐ = 600,000

- Near ‘whole-ten’ or ‘whole-hundred thousands’

19,000 + 29,000 = ☐

199,000 + 299,000 = ☐

- Partitioning

15,000 – 7,000 = 15,000 – 5,000 – 2,000

= $\boxed{}$

284,000 + 37,000 = 284,000 + 16,000 + 21,000

= $\boxed{}$

305,000 – 12,000 = 305,000 – 5,000 – 7,000

= $\boxed{}$

- ‘Small’ differences

41,000 – 38,000 = $\boxed{}$

204,000 – 198,000 = $\boxed{}$

315,000 – 299,000 = $\boxed{}$

4:5

Now extend column addition and column subtraction to five- and six-digit numbers. The children should be confident in column addition and column subtraction already, so you should be able to extend the algorithm to the new columns without having to work through modelling with place-value counters again. Initially, model the column addition with place-value headings, then move children on to working without these.

Work through the following progression:

- addition and subtraction without regrouping (i.e. no column totals greater than nine, e.g. *365,000 + 214,000*)
- addition and subtraction with regrouping (e.g. *365,000 + 258,000*).

Column addition and subtraction:

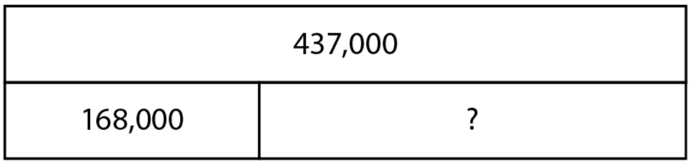
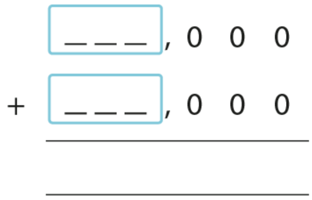
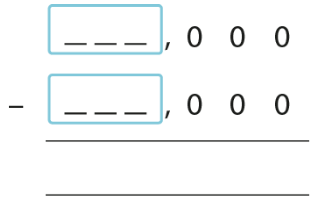
- With place-value headings

	Thousands			**Ones**		
	100s	**10s**	**1s**	**100s**	**10s**	**1s**
	3	6	5	0	0	0
+	2	1	4	0	0	0
	5	7	9	0	0	0

- Without place-value headings

$$\begin{array}{rr} & 365{,}000 \\ + & 214{,}000 \\ \hline & 579{,}000 \\ \hline \end{array}$$

	Model how to insert the thousands separator comma in the answer, directly below that in the addends (or minuend and subtrahend), to make it easier to read out the sum (or difference). Then move on to modelling: • addition and subtraction of numbers with different numbers of digits (e.g. *365,000 + 28,000*) • addition and subtraction of more than two multiples of 1,000 (e.g. *45,000 + 321,000 + 80,000 + 139,000*). Emphasise the importance of clearly lining up digits from the same place-value column, particularly when working on plain paper where it can be harder to keep them correctly aligned. Provide ample calculations for the children to practise, such as those shown opposite.	One-step calculations: *'Fill in the missing numbers.'* 546,000 + 319,000 = ☐ 624,000 – 478,000 = ☐ Multi-step calculations: *'Fill in the missing numbers.'* 445,000 + 281,000 + 79,000 = ☐ 445,000 + 281,000 – 79,000 = ☐ 445,000 – 281,000 + 79,000 = ☐ 445,000 – 281,000 – 79,000 = ☐
4:6	Move on to solving equations presented in different forms to check depth of understanding of the additive structure. Some of the common difficulty points are listed below. • Missing addend: Children sometimes try to 'work up' from the first addend to see what they need to add to get the total. This is fine for equations where the missing addend can easily be calculated this way, e.g.: 450,000 + _______ = 570,000 However, for other equations it is inefficient and prone to error, e.g.: 168,000 + _______ = 437,000. Make sure that children can transform calculations like this to subtractions, so they can then use column subtraction to solve them quickly and accurately. • Missing minuend: Sometimes children don't pay due attention to the format of the	Solving equations: *'Fill in the missing numbers.'* • Missing addend 450,000 + ☐ = 570,000 168,000 + ☐ = 437,000 643,000 = 189,000 + ☐ + 111,111 • Missing minuend ☐ – 532,000 = 378, 000 • Subtraction complements 267,000 = 614,000 – ☐

	equation and, seeing two numbers, a minus sign and a plus sign, will subtract one from the other rather than seeing that they need to add the subtrahend and difference (the two *parts*) to get back to the minuend (the *whole*). - Subtraction complements: Conversely, children can sometimes make a link between equations with missing-number boxes and inverse operations. Subtraction complements provide a situation where the transformation of the equation does not require the use of the inverse operation. Show the children how they can represent each of the above scenarios on a part–part–whole model (bar model or cherry diagram) to help expose the underlying algebraic structure and how they can manipulate the equation to solve it.	- Bar model Transforming $168{,}000 + \boxed{} = 437{,}000$ to $437{,}000 - 168{,}000 = \boxed{}$ 
4:7	As well as providing equations for the children to solve, you can play games that will give opportunity for repeated practice of column addition and column subtraction. One such game is a dice game that children can play in pairs. Each child draws an addition grid as shown opposite. Each child throws the dice six times and chooses where to place the six numbers. Choose a target total (e.g. 800,000). The aim is to make two numbers that give a total as close to the target as possible. Changing the target will change the decisions the children need to make about where to place the numbers. Children will start to realise that to get really close to e.g. 800,000, they need the two hundred thousand digits to add to seven (rather than eight). Throughout the game, stop and highlight strategic talk like this.	Column addition game:  Column subtraction game: 

A similar game can be played for column subtraction, in which children have to place the six numbers to get as close as possible to a target difference (e.g. 200,000). The game can be made more challenging by giving targets that are not multiples of 100,000 (e.g. 250,000).

4:8

Complete this teaching point by looking at addition and subtraction in context.

The approximate population of UK cities provides a context to apply addition and subtraction of six-digit numbers by combining or comparing population sizes. For example, based on the data shown opposite:

- *'Edinburgh is the capital city of Scotland. Cardiff is the capital city of Wales. How many more people live in Edinburgh than in Cardiff?'* (difference)
- *'Leeds and Sheffield are both in Yorkshire. What is the combined population of these two Yorkshire cities?'* (aggregation)
- *'What is the difference in population size between Nottingham and Leicester?'* (difference)
- *'Which city has a population size approximately three hundred thousand larger than Liverpool?'* (comparative addition)
- *'Glasgow is the largest city in Scotland. How many fewer people live in the Scottish capital Edinburgh than live in Glasgow?'* (difference)

Estimated populations of UK local authorities:

Name	Mid-2016 population
London	8,770,000
Birmingham	1,128,000
Leeds	781,000
Glasgow	615,000
Sheffield	574,000
Manchester	541,000
Edinburgh	507,000
Liverpool	488,000
Bristol	456,000
Cardiff	361,000
Leicester	350,000
Nottingham	325,000

Source: *Office for National Statistics*
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Open Government Licence v3.0

- Dòng nǎo jīn*:*
  'Approximately 66 million people live in the UK. Which fraction best represents the fraction of the UK population living in these 12 biggest cities?'

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

Many problems such as the examples above are most efficiently solved through column addition and subtraction; however, prompt mental methods where they may be more efficient, for example, comparing the population size of Nottingham (325,000) and Leicester (350,000).

Note that addition of some of these will give a total of over 1,000,000. Children have not studied these numbers in detail yet, so bear this in mind as you choose questions to solve.

Looking at population sizes of cities and towns in your region of the UK will of course provide a data set with smaller multiples of 1,000.

The London 2012 venues also provide a set of smaller numbers to combine and compare (shown opposite). Here, a lot more of the calculations you provide for the children should be solved mentally, for example:

- *'What is the combined capacity of the two venues in Greenwich?'*
- *'What is the difference in capacity between the largest and second largest venues?'*

London 2012 venue capacities, to the nearest 1,000:

Venue	Sport	Capacity
Olympic stadium	Athletics	80,000
Eton Dorney	Rowing, Canoe sprint	30,000
Wimbledon	Tennis	30,000
Greenwich Park	Equestrian, Modern pentathlon	23,000
North Greenwich Arena	Basketball, Gymnastics	20,000
Aquatics Centre	Diving, Swimming	18,000
Riverbank Arena	Hockey	16,000
Earls Court	Volleyball	15,000
Horse Guards Parade	Beach volleyball	15,000
Lee Valley White Water Centre	Canoe slalom	12,000

Source: *London 2012 Venues Guide*
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Teaching point 5:

Numbers can be rounded to simplify calculations or to indicate approximate sizes.

Steps in learning

Guidance

5:1

In segment *1.22 Composition and calculation: 1,000 and four-digit numbers*, children learnt how to round four-digit numbers to the nearest 10, 100 and 1,000. Referring back to *Teaching point 4* in that segment will show how it was introduced. In this segment, we round multiples of 1,000 to the nearest 10,000 and 100,000.

Begin by looking at the bar chart opposite, showing the number of tickets sold for various sports at the London 2012 Olympics. Give children copies of the graph in pairs so they can see it clearly and make markings on it. First look at the chart and the kind of information it shows and discuss this as a class, for example:

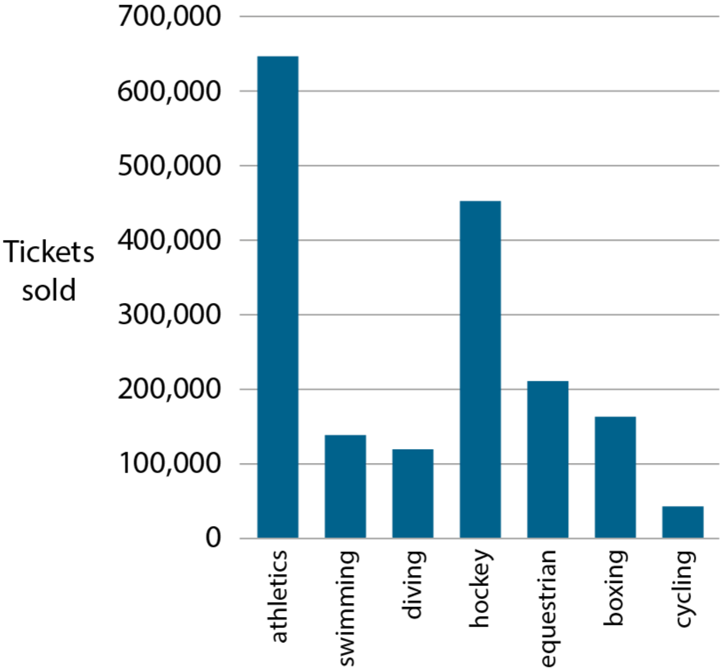
- *'Which sport were the most tickets sold for?'*
- *'Which of these sports were the least number of tickets sold for?'*
- *'Did over half a million people watch any of the sports?'*
- *'Name one sport that between one hundred thousand and two hundred thousand tickets were sold for.'*

You might discuss some of the reasons behind the patterns in the chart. For example, you can fit a lot more people into an athletics stadium than into a swimming pool arena.

We can't tell from the chart exactly how many people viewed each sport. However, using their knowledge from *Teaching point 2*, children should be able to make rough estimations of how many tickets were sold for each sport.

Representations

Tickets sold for different sports at London 2012:



Source: *London Datastore*
Public sector information licensed under the Open Government Licence v2.0

Previous multiple of 100,000	Sport	Next multiple of 100,000
600,000	Athletics	700,000
100,000	Swimming	200,000

- *'The number of tickets sold for athletics is between six hundred thousand and seven hundred thousand.'*
- *'The number of tickets sold for swimming is between one hundred thousand and two hundred thousand.'*

For example, approximately 650,000 tickets were sold for athletics and approximately 140,000 were sold for swimming.

Now move towards thinking about rounding. Taking each sport in turn, ask the children to point to each bar and find the two multiples of 100,000 the value lies between. Record the results in a table. Use the following stem sentence to structure their responses: ***'The number of tickets sold for ___ is between ___ and ___.'***

5:2

Next, ask the children to choose which multiple of 100,000 each value is nearest to, using the height of the bar as a visual cue. They should look carefully at each bar to decide this. Ask: *'Is it above the midpoint or below it?'* The children should circle the nearest multiple of 100,000 for each sport.

Note that the number of tickets sold for athletics is close to 650,000 (645,000) so there may be some debate about whether to round this up or down based on a visual evaluation of the bar height.

Summarise that we have just rounded the number of tickets sold for each sport to the nearest 100,000 and verbalise this using the stem sentence: ***'The number of tickets sold for ___ to the nearest one hundred thousand is ___.'***

Draw attention to the fact that both the equestrian and boxing tickets round to 200,000, even though one was more than 200,000 and one was less.

Rounding to the nearest 100,000:

Previous multiple of 100,000	Sport	Next multiple of 100,000
[✓ 600,000]	Athletics	700,000
[✓ 100,000]	Swimming	200,000

- *'The number of tickets sold for athletics to the nearest one hundred thousand is six hundred thousand.'*
- *'The number of tickets sold for swimming to the nearest one hundred thousand is one hundred thousand.'*

5:3

Now look at the same data presented in a table. Ask the children: *'Can you identify how many tickets were sold for each sport, to the nearest one hundred thousand, from this table?'*

Ask children to write inequalities (as shown opposite) as they did in segment *1.22 Composition and calculation: 1,000 and four-digit numbers*. Use the following stem sentences to reinforce understanding:

- ***'The number of tickets sold for ___ is ___.'***
- ***'The previous multiple of one hundred thousand is ___. The next multiple of one hundred thousand is ___.'***
- ***'___ is nearest to ___.'***
- ***'___ is ___ when rounded to the nearest one hundred thousand.'***

Highlight that it is the 100,000s digit that we use to identify the previous and next multiples of 100,000, but the 10,000s digit is critical in helping us decide whether to round up or round down.

Use a generalised statement similar to the ones children met in segment *1.22*: ***'When rounding to the nearest one hundred thousand, the ten thousands digit is the digit to consider. If it is four or less we round down. If it is five or more we round up.'***

Work through all of the sports, helping children to use unitising to realise that they can use their knowledge of previous and next multiples of 100 to find previous and next multiples of 100,000.

Tickets sold for different sports at London 2012:

Sport	Ticket sales
Athletics	645,000
Swimming	141,000
Diving	114,000
Hockey	458,000
Equestrian	205,000
Boxing	163,000
Cycling	44,000

Source: *London Datastore*
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Inequality:

previous multiple of 100,000

next multiple of 100,000

$\boxed{600{,}000} < 645{,}000 < \boxed{700{,}000}$

- *'The number of tickets sold for athletics is six hundred and forty-five thousand.'*
- *'The previous multiple of one hundred thousand is six hundred thousand. The next multiples of one hundred thousand is seven hundred thousand.'*
- *'Six hundred and forty-five thousand is nearest to six hundred thousand.'*
- *'Six hundred and forty-five thousand is six hundred thousand when rounded to the nearest one hundred thousand.'*

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5:4

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When children first met rounding in segment *1.22: Composition and calculation: 1,000 and four-digit numbers*, they learnt that if a number was exactly at the midpoint it will round up rather than down. Consider some midpoint numbers (e.g. 150,000) and discuss this again here.

Display a number line showing multiples of 100,000. Look at whether numbers at different positions on the number line round up or down, highlighting the midpoints in particular. Refer back to the generalised statement in step *5:3*.

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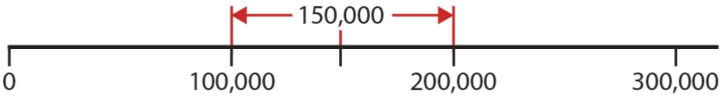
Number line:

'Place each of these numbers on the number line. Does each number round up or down to the nearest hundred thousand?'

150,000 110,000 165,000 149,000



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5:5

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<td>

Now move on to look at how we can round six-digit multiples of 1,000 to the nearest 10,000. As before, a graph of ticket sales for London 2012 (shown opposite, this time for a different set of sports) provides a way to introduce the approximation of values.

Follow the same progression as before, firstly identifying the previous and next multiples of 10,000, before circling the one that each value on the bar chart is closer to, making a visual judgement based on the chart.

This can be more challenging for children and reference to the graph is important to show that, for example, the number of gymnastics tickets sold is 130,000 to the nearest ten thousand, rather than 30,000, which is a relatively common error here. In *'focusing in'* on the part of the number they need to round, children can sometimes forget the other part of the number.

Summarise that we have just rounded the number of tickets sold for each sport to the nearest 10,000 and verbalise this using the stem sentence: ***'The number of tickets sold for ___ to the nearest ten thousand is ___.'***

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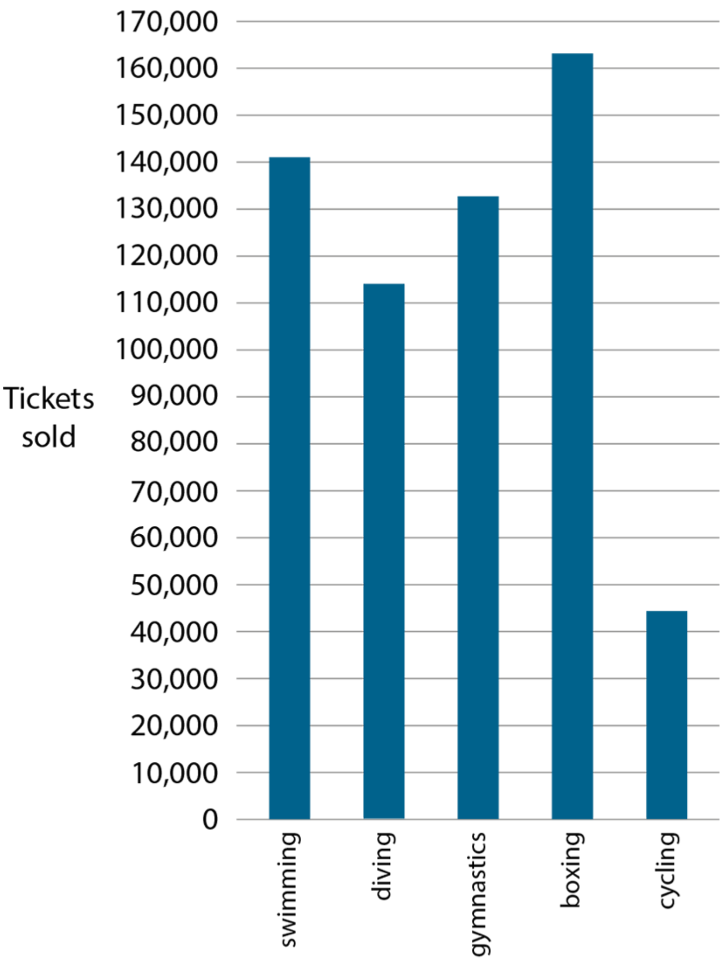
Tickets sold for different sports at London 2012:



Source: *London Datastore*
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Rounding to the nearest 10,000:

Previous multiple of 10,000	Sport	Next multiple of 10,000
140,000	Swimming	150,000
110,000	Diving	120,000

- *'The number of tickets sold for swimming to the nearest ten thousand is one hundred and forty thousand.'*
- *'The number of tickets sold for diving to the nearest ten thousand is one hundred and ten thousand.'*

5:6

As you did for rounding to the nearest 100,000, now look at values that aren't placed on a number line/graph (for example, using the table of ticket sales shown opposite). Identify the previous and next multiples of 10,000 as before. Identify the closer multiple of 10,000. Use the following stem sentences to reinforce understanding:

- ***'The number of tickets sold for ___ is ___.'***
- ***'The previous multiple of ten thousand is ___. The next multiple of ten thousand is ___.'***
- ***'___ is nearest to ___.'***
- ***'___ is ___ when rounded to the nearest ten thousand.'***

Highlight that, as we are rounding to the nearest ten thousand, the 1,000s digit is the important digit to consider. Use the generalised statement: ***'When rounding to the nearest ten thousand, the thousands digit is the digit to consider. If it is four or less we round down. If it is five or more we round up.'***

Work through all of the sports, helping children to use unitising to realise that

Tickets sold for different sports at London 2012:

Sport	Ticket sales
Swimming	141,000
Diving	114,000
Gymnastics	133,000
Boxing	163,000
Cycling	44,000

Source: *London Datastore*
Public sector information licensed under the Open Government Licence v2.0

Inequality:

$$\begin{array}{ccc} \textbf{previous} & & \textbf{next} \\ \text{multiple of} & & \text{multiple of} \\ 10{,}000 & & 10{,}000 \\ \boxed{140{,}000} & < 141{,}000 < & \boxed{150{,}000} \end{array}$$

- *'The number of tickets sold for swimming is one hundred and forty-one thousand.'*
- *'The previous multiple of ten thousand is one hundred and forty thousand. The next multiple of ten thousand is one hundred and fifty thousand.'*

<table>
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<td>they can use their knowledge of previous and next multiples of 10 to find previous and next multiples of 10,000.</td>
<td><i>'One hundred and forty-one thousand is nearest to one hundred and forty thousand. '</i>
<i>'One hundred and forty-one thousand is one hundred and forty thousand when rounded to the nearest ten thousand.'</i></td>
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<td>5:7</td>
<td><p>Summarise how different numbers round to both the nearest 10,000 and 100,000.</p><p>Look too at numbers that are already multiples of 10,000, e.g. 640,000. 640,000 rounded to the nearest 10,000 is, of course, 640,000.</p><p>As children are now moving between rounding to the nearest 10,000 and to the nearest 100,000, make sure they are drawing on the stem sentences from steps <i>5:3</i> and <i>5:6</i> to help identify which digit to consider.</p></td>
<td><p>Rounding to the nearest 10,000 and nearest 100,000:</p><p>133,000
130,000 (nearest 10,000)
100,000 (nearest 100,000)</p><p>640,000
640,000 (nearest 10,000)
600,000 (nearest 100,000)</p></td>
</tr>
<tr>
<td>5:8</td>
<td><p>Finally, provide varied practice for rounding five- and six-digit multiples of 1,000 in a range of contexts, including money and measures, such as those shown opposite and below.</p>
<i>'Round the numbers in these headlines to the nearest 10,000 and 100,000:</i>
<i>273,000 residents displaced by Hurricane Katrina</i>
Source: <i>The Data Center, FEMA</i>
<i>British Museum is top UK tourist destination, with 492,000 visitors each month</i>
Source: <i>ALVA</i>
<i>118,000 square kilometres of rainforest destroyed each year</i>
Source: <i>Scientific American</i>
<i>Messi nets £336,000 per week in latest pay rise</i>
<i>962,000 bars of Milky Chocolate eaten in UK each day'</i>
<p>These also provide a context to discuss the role of rounding in indicating approximate sizes or estimations. Of course, we can't say exactly 273,000</p></td>
<td><p>Rounding to the nearest 100,000 and nearest 10,000:</p><p><i>'Complete the table by rounding the numbers.'</i></p>
<table>
<tr><th></th><th>Rounded to nearest 10,000</th><th>Rounded to nearest 100,000</th></tr>
<tr><td>361,000</td><td></td><td></td></tr>
<tr><td>316,000</td><td></td><td></td></tr>
<tr><td>136,000</td><td></td><td></td></tr>
<tr><td>163,000</td><td></td><td></td></tr>
<tr><td>613,000</td><td></td><td></td></tr>
<tr><td>631,000</td><td></td><td></td></tr>
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	people were displaced by Hurricane Katrina – the exact figure might have been a bit more or a bit less – but it gives us an approximation.	Dòng nǎo jīn: *'Use digit cards 1–9 to complete the following statements.* ***You may use each digit only once.****'* *_ _ _ ,000* *rounded to the nearest 10,000 is 510,000.* *_ _ _ ,000* *rounded to the nearest 10,000 is 400,000.* *_ _ _ ,000* *rounded to the nearest 10,000 is 650,000.*

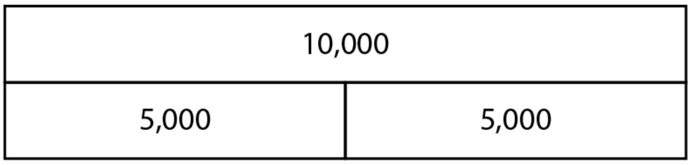
Teaching point 6:

Known patterns can be used to divide 10,000 and 100,000 into two, four and five equal parts. These units are commonly used in graphing and measures.

Steps in learning

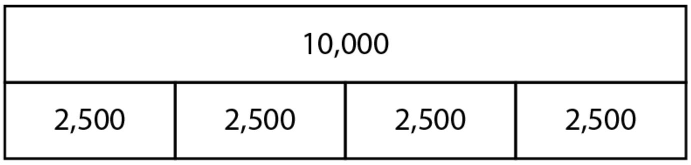
	Guidance	**Representations**
6:1	In segment *1.17 Composition and calculation: 100 and bridging 100*, children learnt that 100 can be composed multiplicatively from 50, 25, 20 or 10. In segment *1.22 Composition and calculation: 1,000 and four-digit numbers*, they extended this by learning that 1,000 can be composed multiplicatively from 500, 250, 200 or 100. The work in this teaching point extends this to look at similar multiplicative compositions for 10,000 and 100,000. Begin by focusing on 10,000. Use bar models to represent that 10,000 can be divided into: • two equal parts of 5,000 • four equal parts of 2,500 • five equal parts of 2,000. This should be familiar to children, based on their work from the earlier segments, so you should be able to work through this quite quickly. Go on to explain that these divisions can help us to read scales. For example, if there are two spaces between multiples of 10,000 marked on a scale, then each division is 5,000. This is because *10,000 ÷ 2 = 5,000*. Bring in a measures context with a simple scale from 0 to 20,000 g, as shown below. Ensure children can accurately read the scale by asking questions such as: • *'What measurement is the arrow pointing to?'* • *'If ten kilograms are added, what will the scales show?'* • *'What needs to be added to make twenty kilograms?'* Encourage children to check this by counting in multiples of 5,000, first up to 10,000 and then beyond (within 1,000,000). Scaffold this counting with missing-number sequences if necessary. You can repeat this with multiples of 2,500 and multiples of 2,000 but it may not be necessary given the familiarity with similar multiplicative compositions from the earlier segments. Finally, present the children with a graph using a scale of two, four or five squares for every 10,000, as shown below. In each case, only the multiples of 10,000 should be labelled. Initially, children might need to write the multiples of 5,000, 2,500 or 2,000 on the scale, so it is important to ensure that they write numbers *on the grid lines*, not in the spaces. Ask: • *'What does the red bar represent?'* • *'What is the difference between the red bar and the blue bar?'* • *'What is the sum of the red and blue bars?'*	

Bar models:



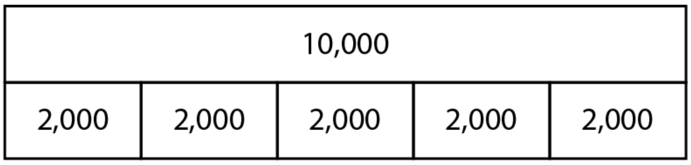
10,000 = 5,000 × 2

10,000 ÷ 2 = 5,000



10,000 = 2,500 × 4

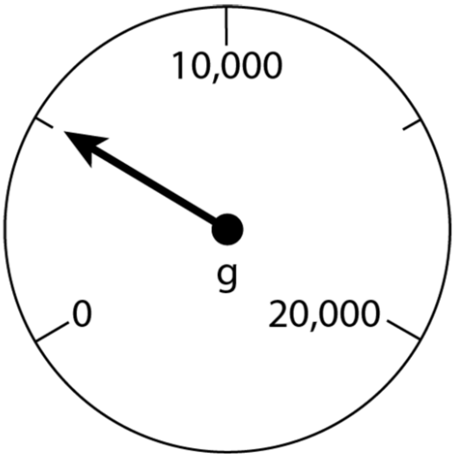
10,000 ÷ 4 = 2,500



10,000 = 2,000 × 5

10,000 ÷ 5 = 2,000

Measures context:



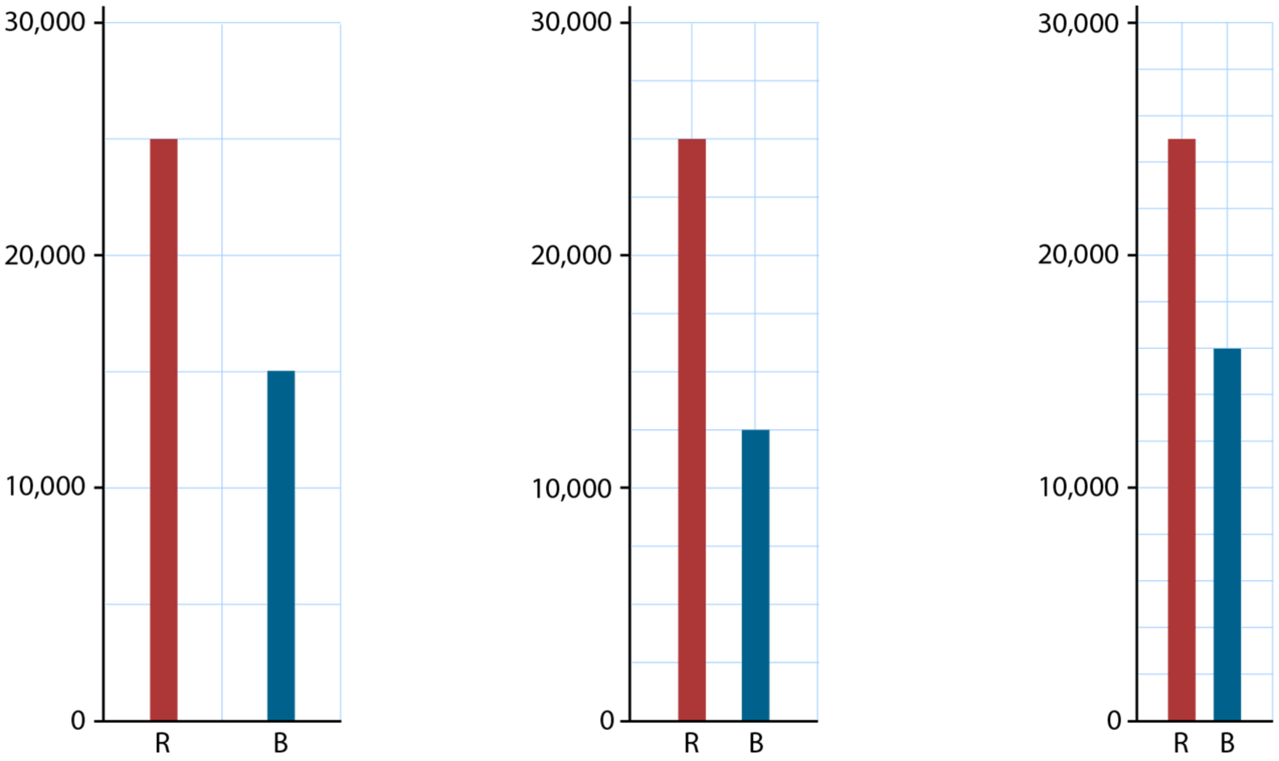
Missing-number sequences:

'Fill in the missing numbers.'

0	5,000	10,000			25,000

	355,000			370,000	375,000

Graphing context:



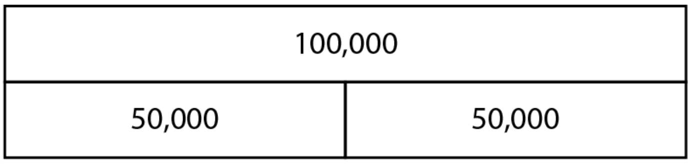
6:2 Next, follow the same progression as in step *6:1* to look at how 100,000 can be divided into:

- two equal parts of 50,000
- four equal parts of 25,000
- five equal parts of 20,000.

Emphasise again that these divisions can help us to read scales. Suitable contexts with large numbers for graphing include:

- changes in populations over time
- monthly (or annual) visitor numbers to tourist attractions
- lengths in metres of Tour de France stages.

Bar models:



100,000 = 50,000 × 2

100,000 ÷ 2 = 50,000

100,000			
25,000	25,000	25,000	25,000

100,000 = 25,000 × 4

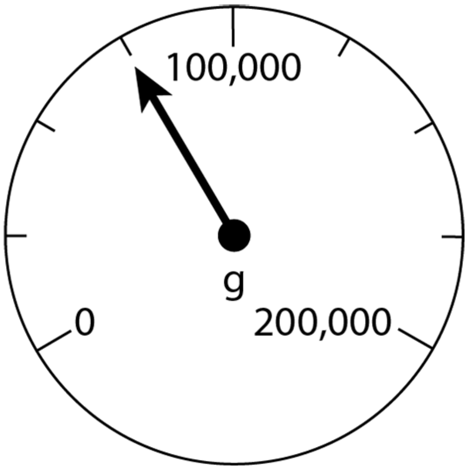
100,000 ÷ 4 = 25,000

100,000				
20,000	20,000	20,000	20,000	20,000

100,000 = 20,000 × 5

100,000 ÷ 5 = 20,000

Measures context:



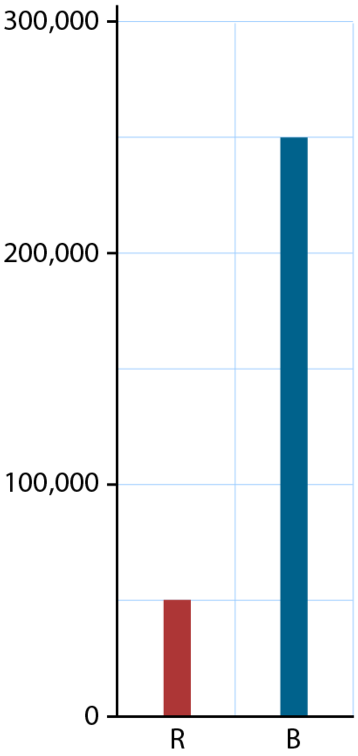
Missing-number sequences:

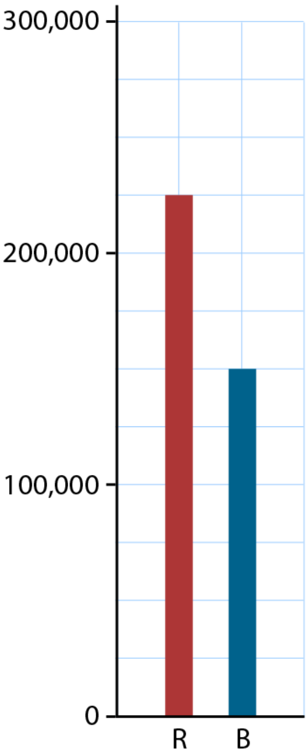
'Fill in the missing numbers.'

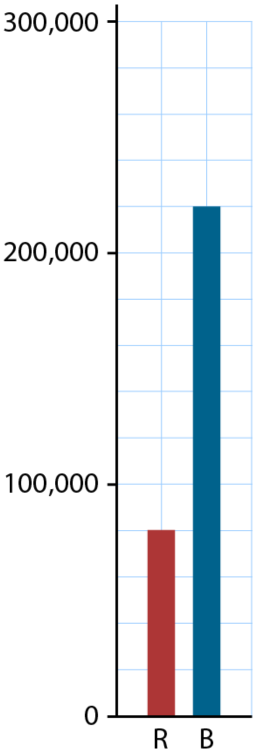
0			150,000		250,000

	620,000	640,000		680,000	

Graphing context:





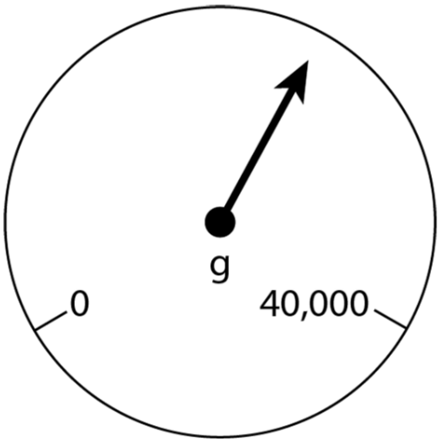


6:3 Extend the work on scales by linking with the learning from *Teaching point 1*. Recall that 10,000 splits up into ten equal parts of 1,000 and 100,000 splits up into ten equal parts of 10,000.

Children should therefore already be able to deduce that if there are ten spaces between multiples of 10,000 marked on a scale then each division is 1,000, because *10,000 ÷ 10 = 1,000*. Likewise, if there are ten spaces between multiples of 100,000 marked on scale then each division is 10,000, because *100,000 ÷ 10 = 10,000*.

6:4 Finally, once children have an understanding of how to read scales by working out the meaning of each division, present them with varied practice using blank scales, such as the problems shown below, for which they must use reasoning.

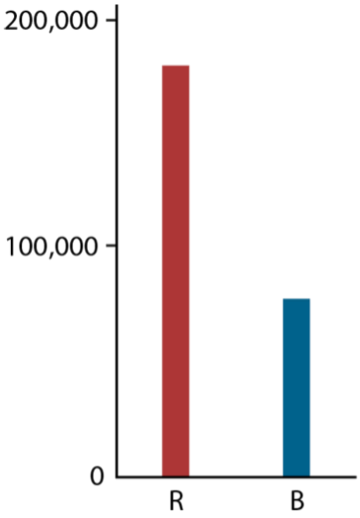
Measures context:



- *'Estimate the measurement the arrow is pointing to.'*
- *'What needs to be added to make 30 kg?'*

Graphing context:

- *'Estimate what the red and blue bars represent.'*
- *'Estimate their difference.'*
- *'Estimate their sum.'*



Dòng nǎo jīn:

'The red bar has a value of 450,000. The blue bar has a value of 340,000.
Draw lines with a value of approximately:

100,000 440,000 219,000'