Number 5

contents

There are six lessons in this unit, **Number 5**.

objectives

The objectives covered in this unit are:

- Recall multiplication facts to 10 × 10 and derive associated division facts.
- Convert one metric unit of length to another.
- Calculate mentally TU × U and TU ÷ U.
- Estimate calculations.
- Use written methods to calculate U.t × U, TU.t × U and TU.t ÷ U.
- Express a quotient in fraction or decimal form.
- Divide £.p by a single-digit number.
- Round up or down after division, depending on the context.
- Use the laws of arithmetic and inverse operations.
- Carry out calculations with more than one step.
- Use a calculator effectively; enter numbers into a calculator and interpret the display in different contexts.
- Check whether a result is the right order of magnitude.
- Solve word problems and investigate in number.

Using the lesson plans in this unit

These lesson plans supplement the *Springboard 7* materials for Key Stage 3 pupils working toward level 4 in mathematics. All the lessons are examples only. There is no requirement to use them. If you decide to use the lessons, you will need to prepare overhead projector transparencies (OHTs) and occasional resource sheets for pupils to use.

The lessons consolidate work at level 3 and extend into level 4. They are suitable for a group of pupils or a whole class. Whatever the size of the group, the pupils are referred to as 'the class'.

Each lesson will support about 30 to 40 minutes of direct teaching. To help match the time to your timetable, each plan refers to 'other tasks' for pupils, based on *Springboard 7* resources. Select from these, textbook exercises or your own materials to provide practice and consolidation in the main part of a lesson and to set homework. Aim to choose tasks that vary in their level of demand, to suit pupils' knowledge, confidence and rate of progress.

Although the 'other tasks' are listed for convenience at the end of the main part of the lesson, they can be offered at any point, especially between the 'episodes' that form the main activity.

The lesson starters are of two kinds: practice starters and teaching starters. The former are opportunities to rehearse skills that will be needed later in the lesson. Teaching starters introduce an idea that is then developed in the main activity.

You will need to tell pupils what they will learn in the lesson, either in the starter or at the beginning of the main activity. Use the plenary to check pupils' learning against the lesson's objectives and to draw attention to the key points that pupils should remember.

N5.1 Multiplying a decimal by a single-digit number

objectives

- Recall multiplication facts to 10 × 10 and derive associated division facts.
- Use written methods to calculate U.t × U and TU.t × U.
- Check whether a result is the right order of magnitude.

starter

Vocabulary
multiplied by
divided by
product
multiple
remainder

As a class, chant the seven times table, forwards and backwards. Ask a few random questions, varying the wording.

Q What is 7 multiplied by 9?

Q What is 35 divided by 7?

Q What is the product of 3 and 7?

Q What is seven squared?

Q What is the next multiple of 7 after 77? How did you work it out?
(add 7 to 77)

Q What is the remainder when 45 is divided by 7?

Discuss ways to remember awkward facts. For example, to remember 10 times a number is always easy. To find 5 times a number is also easy, as it is half of ten times the number. For example, 10 times 7 is 70, so 5 times 7 is half of 70, or 35.

Use this method to practise finding 5 times 16, 5 times 24, 5 times 13. Model how to jot down interim answers (e.g. to jot down 16, 160, 80). Extend to finding 5 times 1.4, 5 times 0.46, 5 times 10.8.

main activity

Vocabulary
estimate

Resources
mini-whiteboards
Resource N5.1a (two playing boards)
dice (one per pair)
calculators

Write on the board 4 × 7, and 4 × 0.7 immediately below it.

Q Which one can you answer?

Establish that 7 is ten times bigger than 0.7 and that 0.7 is ten times smaller than 7. Ask the class:

Q How can we use the answer to 4 × 7 to work out 4 × 0.7?

Establish that they need to divide the answer to 4 × 7 by 10. Write:

$4 \times 7 = 28$ $\quad 28 \div 10 = 2.8$
$4 \times 0.7 = 2.8$

Remind pupils that multiplication can be done in any order: for example,

$7 \times 4 = 4 \times 7$ and $4 \times 0.7 = 0.7 \times 4$

Q Can you work out 4 × 0.07 or 0.07 × 4?

Establish that this time 28 has to be divided by 100, so that:

$4 \times 0.07 = 28 \div 100 = 0.28$

Write on the board 9 × 3, 9 × 0.03 and 9 × 0.003. Ask pupils to show the answer on their whiteboards. Repeat for other examples, including some in the form 0.06 × 5, stressing that 0.06 × 5 = 5 × 0.06.

Write $7 \times 3.8 = 3.8 \times 7$ on the board.

Q What is an estimate of the answer?

Establish that the answer will lie between $3 \times 7 = 21$ and $4 \times 7 = 28$. It will be closer to 28 than to 21, since 3.8 is closer to 4 than to 3.

Point out that 3.8 can be written as 3 + 0.8. Draw a grid on the board.

×	3	0.8
7		

×	3	0.8
7	21	5.6

Work through the left-hand grid with the class to get the right-hand grid. Ask:

Q How can we get the answer to 3.8×7 from the grid?

Add 21 and 5.6 mentally to get the answer 26.6. Repeat with 31.2×4.

Ask pupils to work in pairs. Give each pair of pupils a copy of **Resource N5.1a** and a dice. They will also need a pencil and jotting pad.

0.5	1.2	1.4	0.6	0.3

1.4	4.2	2.0
6.0	2.4	7.0
1.5	1.8	4.8

1.2	8.4	0.9
2.0	3.6	2.5
3.0	2.4	5.6

Each player uses one of the square grids. Players take turns to roll the dice. If they can multiply one of the five numbers at the top by the number on the dice to obtain a number on their playing board, they can cross out the number on the grid. The other player checks with a calculator. If players cannot cross out a number, they miss a turn. The winner is the first player to cross out every number on their board.

Emphasise that pupils are finding the *product* of the number on the dice and the number on one of the cards.

If appropriate, bring the class together for this demonstration. Say that they will normally use a calculator for a more difficult calculation like this one but you want to show how the method works with numbers with more digits as they have the skills to follow the steps.

Write on the board $23.6 \times 47 = 47 \times 23.6$. Estimate the answer as about $20 \times 50 = 1000$.

Discuss how to write 23.6 as 20 + 3 + 0.6 as you set out the grid.

×	20	3	0.6
40			
7			

×	20	3	0.6
40	800	120	24
7	140	21	4.2
	940	141	28.2

Q What is the answer to 0.6×40?

Draw on earlier work and remind pupils that:

$0.6 \times 40 = 0.6 \times 10 \times 4 = 6 \times 4 = 24$

Q What is the answer to 0.6×7?

Remind them that $6 \times 7 = 42$. Since 0.6 is ten times smaller than 6:

$0.6 \times 7 = 42 \div 10 = 4.2$

Complete the grid. Establish that, to get the answer, numbers in the columns must be added to get the bottom row. The numbers 940, 141 and 28.2 in the bottom row can be added using column addition. Record the answer of 1109.2 and check against the estimate.

other tasks

Springboard 7
Units 2, 6 and 10

Unit 2 section 6: Calculating with money
Star challenge 10: Meet the @ symbol page 90

Unit 6 section 2: Mental calculations
4 Multiplying simple decimals in your head page 220
Star challenge 3: Multiplication mix page 221

Unit 6 section 5: Multiplication
5 Multiplication for U.t × U page 233

Unit 10 section 2: Multiplication
2 Multiplying money and measurements page 333

plenary

Resources
self-prepared OHT of numbers (optional)

Ask the class to choose three different digits from 1 to 9. Write these on the board. Show pupils how to use the digits to make a product of the form:

$\square.\square \times \square$

Q What other products in this form can you make with those digits?

Establish that there are five other possible products.

Q What is the smallest answer that you can get? How do you know?

Ask pupils to complete the calculations individually in their jotters. After five minutes or so, check the answers with the class.

Remember

- Before multiplying it, split a number into its parts – e.g. into tens, units or ones, tenths, hundredths – and multiply each separately. Then add together the answers.
- To multiply by 0.4, first multiply by 4, then divide by 10; to multiply by 0.04, first multiply by 4, then divide by 100.

N5.2 Remainders

objectives

- Recall multiplication facts to 10 × 10 and derive associated division facts.
- Calculate mentally TU × U and TU ÷ U.
- Express a quotient in fraction or decimal form.
- Divide £.p by a single-digit number.

starter

Vocabulary
remainder
divided by

Resources
digit cards or mini-whiteboards

As a class, chant the six times table, forwards and backwards. Tell pupils that it is often possible to work out a calculation like 17 × 6 in their heads. Show them how to split the larger number and to jot down each part.

	17		
10	+	7	
↓		↓	× 6
60	+	42	= 102

They could choose to write this as 17 × 6 = (10 + 7) × 6 = 60 + 42 = 102. Practise a couple of examples, such as 18 × 5 and 24 × 3. Then extend to decimals, with a calculation like 1.4 × 7.

	1.4		
1	+	0.4	
↓		↓	× 7
7	+	2.8	= 9.8

Say that they could write this as 1.4 × 7 = (1 + 0.4) × 7 = 7 + 2.8 = 9.8. Practise a couple of examples, such as 2.3 × 5 and 3.4 × 6.

Explain that a calculation like 91 ÷ 7 can be done similarly. However, the first number has to be split in a slightly different way, into the largest multiple of 10 that is an exact multiple of the divisor 7, plus the rest. So 91 is split into 70 + 21.

	91		
70	+	21	
↓		↓	÷ 7
10	+	3	= 13

Practise some examples, such as 85 ÷ 5 (splitting 85 into 50 + 35) and 78 ÷ 3 (splitting 78 into 60 + 18).

main activity

Vocabulary
remainder

Resources
digit cards or mini-whiteboards

Say that sometimes a number will not divide exactly. The remainder is what is left over.

Q What is the remainder when 26 is divided by 6?

Q How do you know that you are right?

Remind pupils that if they are asked to explain how they know they are right, it is helpful to describe or write a calculation. Establish that 26 = (6 × 4) + 2, and that 2 is the remainder.

Tell the class that you are going to call out some numbers. You want them to use their digit cards or whiteboards to show what the remainder would be when that number is divided by 6. Call out whole numbers less than 60, and check responses. Each time, ask:

Q How do you know that you are right?

Write on the board 21 ÷ 5. Establish that this is 4 r 1, and complete 21 ÷ 5 = 4 r 1.

Draw an empty number line on the board. Demonstrate jumping on in steps of 5 to 20, then count the jumps: one, two, three, four. Say that four fives jump to 20. Establish that five fives would jump to 25 and would be too much. The answer to 21 ÷ 5 must be greater than 4 but less than 5. To get to 21 would need four and a bit fives.

Write on the board 21 = 20 + 1. Point to the 20 and say: '20 divided by 5 equals 4'. Point to the 1, and ask:

Q How could we represent 1 divided by 5?

Establish that 1 ÷ 5 is $\frac{1}{5}$. Say that 21 ÷ 5 = $4\frac{1}{5}$. Record:

21 ÷ 5 is 4 r 1 or $4\frac{1}{5}$

Repeat the above for 23 ÷ 5 and 24 ÷ 5, and record in the same way:

23 ÷ 5 is 4 r 3 or $4\frac{3}{5}$ 24 ÷ 5 is 4 r 4 or $4\frac{4}{5}$

Q What do you think the answer to 22 ÷ 5 will be?

Establish that the answer to 22 ÷ 5 is 4 r 2 or $4\frac{2}{5}$.

Q How can we write $\frac{2}{5}$ as a decimal? (0.4)

Remind pupils that $4\frac{2}{5}$ can be written as 4 + 0.4 = 4.4.

Repeat for $4\frac{3}{5}$ and $4\frac{4}{5}$.

Ask the class:

Q £27 is shared equally among 5 people. How much does each person get?

Establish that the answer to 27 ÷ 5 is $5\frac{2}{5}$ or 5.4.

Q What amount of money does this represent? (£5.40)

Write on the board 63 ÷ 10. Establish that this is 6 r 3. Use an empty number line to demonstrate that the answer will be greater than 6 but less than 7.

Write 63 ÷ 10 = (60 ÷ 10) + (3 ÷ 10).

Point to 60 ÷ 10, and ask for the answer (6). Point to 3 ÷ 10, and ask for the answer (three tenths or 0.3).

Complete 63 ÷ 10 = (60 ÷ 10) + (3 ÷ 10) = 6 + $\frac{3}{10}$ = $6\frac{3}{10}$.

Q How can we write $6\frac{3}{10}$ as a decimal?

Establish that $6\frac{3}{10}$ = 6 r 3 = 6.3.

Q How would you explain your answer to 94 ÷ 10?

Establish that 94 ÷ 10 can be written as (90 ÷ 10) + (4 ÷ 10) = 9 + $^4/_{10}$. Stress that the remainder of 4 is divided by 10 to give $^4/_{10}$.

Q How can we write $9\,^4/_{10}$ as a decimal?

Establish that $9\,^4/_{10}$ = 9 r 4 = 9.4.

Ask pupils to choose whole numbers to divide by 10, and write their answers in both fraction and decimal form. Take feedback and discuss methods.

other tasks

Springboard 7
Units 10 and 15

Unit 10 section 4: Division II

1 Review of division — page 340

Star challenge 8: You choose the method — page 341

Unit 10 section 6: Money and 'real life' problems

1 Dividing with a calculator — page 350

Unit 15 section 2: Mental calculations – division

2 Dividing whole numbers with fraction answers — page 478

plenary

Resources
self-prepared OHT of numbers (optional)

Remind the class that, when dividing by 10, the remainder is divided by 10, and can be written as a fraction in tenths. When dividing by 5, the remainder is divided by 5, and can be written as a fraction in fifths. In each case there are decimal equivalents.

Q What is the answer to 13 ÷ 2?

Establish that answer is 6 r 1. The remainder is 1, which will be divided by 2, and then written as $^1/_2$, so that the answer to the calculation is $6\,^1/_2$ or 6.5.

Q What is the answer to 33 ÷ 4?

Establish that the answer is 8 r 1, and that the remainder of 1 will be divided by 4. This can be written as $^1/_4$ or its decimal equivalent of 0.25, to make an answer of $8\,^1/_4$ or 8.25. Refer to the number line, if necessary.

Ask the class to divide 19 by 2, 4, 5 and 10. Record the answers, in remainder form, and in fraction and decimal equivalents.

Remember

- When dividing by 10, the remainder will be tenths. A remainder of 7 can be represented as $^7/_{10}$ or 0.7.
- When dividing by 2, any remainder is 1, represented as $^1/_2$ or 0.5.
- When dividing by 4, the remainder will be quarters. A remainder of 1 can be represented as $^1/_4$ or 0.25, and of 3 as $^3/_4$ or 0.75.

N5.3 Dividing a decimal by a single-digit number

objectives

- Recall multiplication facts to 10 × 10 and derive associated division facts.
- Estimate calculations.
- Use a written method to calculate TU.t ÷ U.
- Round up or down after division, depending on the context.

starter

Vocabulary
divided by
remainder

Resources
digit cards or
mini-whiteboards

As a class, chant the eight times table, forwards and backwards.

Q What is the remainder when 26 is divided by 8? Explain why you are right.

Remind pupils that if they are asked to explain how they know they are right, it is helpful to describe or write a calculation. Establish that 26 = (8 × 3) + 2, and that 2 is the remainder. The remainder can be written as $^{2}/_{8}$ or $^{1}/_{4}$ or 0.25.
So 26 ÷ 8 = 3.25.

Tell the class that you are going to call out some numbers. You want them to use their digit cards or whiteboards to show what the remainder would be when that number is divided by 8. Call out whole numbers less than 80, and check responses. Ask individual pupils to explain why they are right.

main activity

Vocabulary
round up or down

Resources
mini-whiteboards
OHT N5.3a

Write on the board 48 ÷ 8, and 4.8 ÷ 8 immediately below it.

Q Which one can you answer?

Establish that 48 is ten times bigger than 4.8 and that 4.8 is ten times smaller than 48.

Q How can we use the answer to 48 ÷ 8 to work out 4.8 ÷ 8?

Establish that we need to divide the answer to 48 ÷ 8 by 10. Write:

48 ÷ 8 = 6 6 ÷ 10 = 0.6
4.8 ÷ 8 = 0.6

Q Can you work out 0.48 ÷ 8?

Establish that this time 48 ÷ 8 has to be divided by 100, so that:

48 ÷ 8 = 6 6 ÷ 100 = 0.06
0.48 ÷ 8 = 0.06

Write on the board 35 ÷ 7, 3.5 ÷ 7 and 0.35 ÷ 7. Ask pupils to show the answers on their whiteboards. Repeat for other examples.

Show the first problem on **OHT N5.3a**.

A baker made 67 buns.
The baker packed the buns in boxes of 4.
How many boxes did the baker pack?

Ask pupils to work in pairs for a few minutes to try to answer the problem, then take feedback.

Establish that we need to know how many fours there are in 67, or 67 ÷ 4. Establish that the answer to this problem will be a whole number bigger than 10 (enough boxes for 40 buns) and less than 20 (enough boxes for 80 buns), but that it will be closer to 20 than to 10 because 67 is closer to 80 than to 40.

One way to work out the answer would be to keep subtracting four buns to put in a box but that this might take a long time. It would be easier to take away 40 buns for 10 boxes and then see what is left.

Write on the board:

67 ÷ 4	
67	
40	4 × 10
27	
24	4 × 6
3	

Q How many lots of 4 buns have we taken away? (10 + 6 = 16)

Establish that the answer to 67 ÷ 4 is 16 r 3 (or $16\frac{3}{4}$).

Q Do we need to round $16\frac{3}{4}$ up to 17 or down to 16?

Ask pupils to discuss this in pairs for a few seconds, then establish that, in the context of the problem, the answer needs to be rounded down to 16.

Work through the second problem on **OHT N5.3a** in a similar way.

143 people are going to a wedding reception.
They will sit at tables for 6 people.
What is the least number of tables needed?

Establish that the answer will lie between 20 tables (for 120 people) and 30 tables (for 180 people) but will be closer to 20 than to 30. This time the answer of 23 r 5 (or $23\frac{5}{6}$) needs to be rounded up to 24.

Show the third problem on **OHT N5.3a**.

John spent £8.54 on 7 pens.
How much was each pen?

Establish that the answer to this problem will be more than £1 and less than £2, and that it will be 100 times smaller than £854 ÷ 7.

Write on the board: 854 ÷ 7

854	
700	7 × 100
154	
70	7 × 10
84	
70	7 × 10
14	
14	7 × 2
0	

Establish that the answer to £854 ÷ 7 is £122. The answer to the original problem is 100 times smaller, and is £1.22. This is compatible with the estimate.

Show pupils how the calculation could be more efficient:

854	
700	7 × 100
154	
140	7 × 20
14	
14	7 × 2
0	

Work through the fourth problem on **OHT N5.3a**.

The Town Hall is 13.6 metres tall.
A model of it is one eighth of its size.
How tall is the model?

other tasks

Springboard 7
Unit 15

Unit 15 section 2: Mental calculations – division

4	Dividing whole numbers with decimal answers	page 479
Star challenge 3: Division challenges		page 480
Star challenge 4: Problems		page 480

Unit 15 section 4: Division – written methods

1	Sensible answers to mental problems	page 484
2	Review of division	page 484

plenary

Resources
self-prepared OHT of division calculations (optional)

Show a self-prepared OHT with a few examples of division calculations, some that could be done mentally (e.g. 2.4 ÷ 6, 0.49 ÷ 7), and some that might involve a written method (e.g. 38.25 ÷ 5, 44.1 ÷ 9). Alternatively, write a selection on the board. Point to the calculations one at a time.

Q What advice would you give a friend about how best to do this calculation?

Q How do you think your friend should check the answer?

Remember

- Look back at the question and ask yourself whether it makes sense to round up the answer or round it down.

N5.4 Inverse operations with decimals

objectives

- Use the laws of arithmetic and inverse operations.
- Use a calculator effectively; enter numbers into a calculator and interpret the display in different contexts.

starter

Vocabulary
what must be added to …?
what must you subtract from …?
inverse
operation

Resources
mini-whiteboards
calculators

Call out a decimal such as 5.6 for pupils to enter into their calculator.

Q What is the next whole number? (6)

Ask pupils to add a number to the number in their display to make the next whole number, in this case, 6. Check that all displays are correct.

Q What keys did you press?

Q What do we need to do to get back again to 5.6?

Establish that they need to subtract the number that they have just added, 0.4.

Repeat with 14.2 and 0.7.

Now call out a decimal with tenths and hundredths, such as 4.57 or 56.82. Ask pupils to make it up to the next whole number, then 'undo' the operation to get back to the original number. If necessary, use a number line, showing how to add hundredths to make the number up to the next tenth, then tenths to make the next whole number.

Explain that addition and subtraction are inverse operations in that one reverses the other. Inverse operations can help to solve problems.

main activity

Vocabulary
equation

Resources
mini-whiteboards
calculators

Write on the board: 7 + 2 = 9. Explain that this number sentence or equation is one of a family of four.

Q What are the other three number sentences?

Establish that they are:
2 + 7 = 9
9 – 7 = 2
9 – 2 = 7

Invite a pupil to write another simple sum on the board. Ask the class to use their whiteboards to write an equivalent number sentence. Check that all three possibilities are among the responses.

Write 5.8 + 0.2 = ☐ on the board. Establish that the answer is 6 and that it goes in the box.

Write 5.8 + ☐ = 6, immediately below 5.8 + 0.2 = ☐. Explain this is the same number sentence but that a different bit is missing. The way to think of it is: 'What do I need to add to 5.8 to make 6?' Establish that the answer is 0.2.

Explain that another way to tackle the problem would be to rearrange the equation 5.8 + ☐ = 6.

Q What are the other three equations we could write?

Establish that they are: $\square + 5.8 = 6$
$6 - \square = 5.8$
$6 - 5.8 = \square$

Q Which of these would be easy to complete?

Q What is the answer?

Repeat with $11.3 + \square = 15.1$. This time use calculators to complete the final calculation. Remind the class that they should 'show their working' by writing: $15.1 - 11.3 = 3.8$. They can check their calculation by adding 11.3 to get back to 15.1.

Now take a subtraction example, and work through it in a similar way. Write $10 - 0.7 = \square$ on the board. Establish that the answer is 9.3.

Write below it $10 - \square = 9.3$. Say that the way to think of it is: 'What do I need to subtract from 10 to get 9.3?' Say that they might also rearrange the equation.

Q What are the other three equations we could write?

Establish that they are: $\square + 9.3 = 10$
$9.3 + \square = 10$
$10 - 9.3 = \square$

Point out that the last calculation can be done mentally.

Repeat with $52.37 - \square = 35.6$, using a calculator to complete the final calculation. Working should be shown as: $52.37 - 35.6 = 16.77$. Adding 35.6 to get back to 52.37 can check the calculation.

Say that it is possible to do something similar with multiplication and division. Multiplication reverses division and division reverses multiplication. They are inverse operations. Write on the board $8 \times 7 = 56$.

Q What are the other three number sentences?

Establish that they are: $7 \times 8 = 56$
$56 \div 8 = 7$
$56 \div 7 = 8$

Invite a pupil to write another simple product on the board. Ask the class to use their whiteboards to write an equivalent number sentence. Check that all three possibilities are among the responses.

Write $7 \times 9 = \square$ on the board. Establish that the answer is 63 and that it goes in the box.

Write $7 \times \square = 63$ immediately below. Say this is the same number sentence but that a different bit is missing. The way to think of it is: 'What do I need to multiply 7 by to make 63?' Establish that the answer is 9.

Explain that another way to tackle the problem would be to rearrange the equation $7 \times \square = 63$.

Q What are the other three equations we could write?

Establish that they are: $\square \times 7 = 63$
$63 \div \square = 7$
$63 \div 7 = \square$

Confirm with the class that the last equation is straightforward to complete.

Repeat with $627.8 \div \square = 36.5$, using a calculator to complete the final calculation. Stress that they should 'show their working' by writing $627.8 \div 36.5 = 17.2$, and that they can check their calculation by multiplying by 36.5 to get back to 627.8.

other tasks

Springboard 7
Units 6 and 10

Unit 6 section 6: Division

Star challenge 10: Multiplication and division puzzles page 236
Star challenge 11: Division in disguise page 237

Unit 10 section 2: Multiplication

Star challenge 6: Arithmetic puzzles page 336

plenary

Resources
Resource N5.4a

Ask pupils to group themselves in fours. Give each pupil a quarter sheet of plain A4 paper. Ask them to write an equation at the top of the paper. The equation should be in one of these forms:

$A \times \square = B$
$A \div \square = B$
$A + \square = B$
$A - \square = B$

where A and B are numbers up to 30. Each pupil then passes the paper to the person on their left to write an equivalent equation. Repeat this twice more. Finally, the paper gets passed back to the original person, who checks that all four forms of the equation have been used.

Choose one or two pupils to write their group's four equations on the board.

Finish with a selection of mental arithmetic questions taken from National Curriculum tests, reading them from **Resource N5.4a**.

Remember

- You can make three other equivalent number sentences using the three numbers from any addition, subtraction, multiplication or division statement.
- When finding a missing number, it is helpful to write down the other three number sentences, and then to decide which one to use.
- Always put your answer back in the question to make sure that it works.
- To 'show your working', write out the calculation that you did, together with the answer.

N5.5 Word problems involving decimals

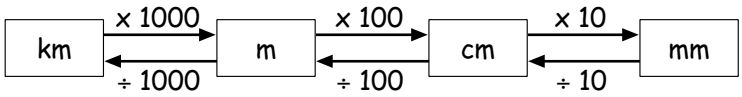
objectives

- Convert one metric unit of length to another.
- Solve word problems.
- Estimate calculations.
- Use a calculator effectively; enter numbers into a calculator and interpret the display in different contexts.
- Round up or down after division, depending on the context.
- Check whether a result is the right order of magnitude.

starter

Vocabulary
metric
kilometre
metre
centimetre
millimetre

Remind pupils how to convert metric units of length. Draw this diagram on the board.



Ask pupils to work mentally to convert these measurements.

Q What is 25 millimetres in centimetres?
Q What is 2.75 metres in centimetres?
Q What is 6.5 metres in millimetres?
Q What is 103 centimetres in metres?

Read the statements below to the class, one by one. Ask pupils to hold up a hand if they think the statement is sensible.

- The classroom is 10 metres long.
- I am 3 metres tall.
- The book is 21 centimetres wide.
- The pen is 100 millimetres long.
- The classroom is 1000 millimetres high.
- Patrick cycles 45 kilometres to school.
- Laura walks 200 metres to school.
- The swimming pool is 2500 centimetres long.

main activity

Vocabulary
problem
calculation

Resources
OHP calculator
OHT N5.5a

Enter 2.5 on the OHP calculator.

Q This is the answer to a calculation. What might the calculation be?

Encourage them to consider all four operations, such as:

1.25 + 1.25 20 – 17.5 0.5 × 5 10 ÷ 4

Write their suggested calculations on the board. Work with the class to do the calculation, either mentally or with the OHP calculator, as appropriate. Now point in turn to each suggestion.

Q What money problem or measurement problem would require you to do that calculation?

Discuss their responses, including sticking points, such as that 0.5 represents 50p in the context of money.

Show the first part of the first two-part problem on **OHT N5.5a**.

Some children do a sponsored walk.
Jason is sponsored for £3.45 for each lap.
He does 23 laps.
How much money does he raise?

Read the problem aloud and clarify the vocabulary. Ask the class:

Q What do you think the problem is asking you to do?

Q What information do we get from the problem? What are the key words? What are the key numbers?

Q What calculation do you need to do?

Ask pupils to record the calculation: 3.45 × 23.

Q How will you do that calculation: in your head, using a written a method, or using a calculator?

Q Approximately, what do you think the answer will be? (4 × 20 = 80)

Q What is the answer to the question? Are there any units to put in?

Q Does the answer make sense and feel 'about right'?

Q How can you check the answer?

Show the second part of the problem, or write it on the board.

Lynne wants to raise £100.
She is sponsored for £6.50 for each lap.
What is the least number of whole laps she must do?

Work through the questions again and establish that the calculation required is 100 ÷ 6.5. Discuss whether the calculator answer of 15.384 615 should be rounded up or down in the context of the problem. Get pupils to put the rounded answer in a sentence, such as: 'The least number of whole laps that Lynne must do is 16.'

Repeat with the second two-part problem on **OHT N5.5a**.

Some children go camping.
It costs £2.20 for each child to camp each night.
They go for 6 nights.
How much will each child have to pay for the 6 nights?

There are 70 children.
Each tent takes up to 6 children.
What is the least number of tents they will need?

Give pupils a selection of problems to solve, working in pairs. After a suitable time, take feedback, inviting a pair to explain their solution to the class.

other tasks

Springboard 7
Units 6 and 15

Unit 6 section 4: Subtraction
Star challenge 8: Money problems page 229

Unit 15 section 4: Division – written methods
Star challenge 7: Choose the method page 486

Unit 15 section 6: Money and 'real life' problems
1 In the real world page 491
Star challenge 9: Money problems page 492

plenary

Write on the board the statement: 'A ride at the fair costs £3.50.'

Q What questions can you ask using this information?

Encourage varied questions, drawing attention to key words and phrases, such as:

- What is the cost of 4 rides?
- How much change from £10 do you get for 2 rides?
- How many rides can you get for £20?

Get pupils to identify the calculation they would need to make to answer each question, and then to calculate the answer mentally.

Now write on the board the statement: 'The fairground takes over £1000 for the rides it sells on a Friday night.' Ask pupils again to suggest the questions they could ask about this information. Select a question along the lines of:

- What is the least number of rides that were sold?

Establish that the calculation needed is 1000 ÷ 3.5, and that the answer of 285.71428 needs to be rounded up in the context of the question.

Remember

- Read the question carefully. Look for key words in the question to help decide what operation to use and what calculations to do.
- Decide what information you need for your calculations.
- Use the calculation method that you understand.
- If a question asks you to 'show your working', write out the calculation you did.

N5.6 Reasoning about numbers (× and ÷ problems)

objectives

- Solve word problems and investigate in number.
- Carry out calculations with more than one step.
- Enter numbers into a calculator and interpret the display in different contexts.

starter

Vocabulary
product
problem
calculation
inverse operation

Resources
mini-whiteboards
calculators
OHP calculator
OHT N5.6a

Show the first problem on **OHT N5.6a**.

I multiply by number by 27. The product is 702. What is my number?

Remind the class of the meaning of 'product'. Ask pupils to write an equation that represents the problem.

Write on the board $\square \times 27 = 702$.

Q What strategies would you use to solve this problem using a calculator?

If necessary, prompt pupils about using inverse operations. Establish that:

$\square \times 27 = 702$ is equivalent to $\square = 702 \div 27$.

Demonstrate finding the answer on an OHP calculator. Check the answer by substituting it back in the box and confirming that $27 \times 26 = 702$.

Q What if you had no calculator? What strategies would you use?

Give pupils a couple of minutes to discuss their possible strategies in pairs. They should recognise that the units digits of the unknown number must be 6, since 6×7 is the only multiple of 7 in the seven times table that ends in 2.

Discuss some approximations for the product. For example, 27×16 is less than $30 \times 20 = 600$, so 16 is too small. 27×36 is more than $25 \times 30 = 750$, so 36 is too big. The unknown number must be 26.

Check by multiplying 27 by 26 using a written method.

Give pupils the second and third problems on **OHT N5.6a** to solve using their calculators.

$1053 \div \square = 39$ $\square \div 19.2 = 14.5$

main activity

Vocabulary
factor

Resources
calculators
OHT N5.6a

Write on the board $\square\square \times 8 = 14\square$, or show the fourth problem on **OHT N5.6a**. Explain that, unlike the previous problem, this time each box stands for a single digit, so that $\square\square$ is a two-digit number.

Q Explain the problem in your own words.

Establish that the task is to find a two-digit number which, when multiplied by 8, results in a 'one hundred and forty-something' number.

Q How could we begin to solve this problem?

Q What could the last digit of the three-digit number be?

Establish that this digit can be only 0, 2, 4, 6 or 8, since a number multiplied by 8 must be even.

Q What could the first digit of the two-digit number be? Could it be 5? (no, the product would be at least 400) **Could it be 2?** (still too big)

Discuss ways of finding the answer by working systematically. For example, they could multiply every number between 10 and 19 by 8 in turn to see which one produces a solution.

Q Is there another way of representing the problem in an equation?

Prompt them to think of the inverse, and invite a pupil to the board to write:

$14\square \div 8 = \square\square$

By working systematically, they could try each of the numbers 140, 142, 144, 146, 148 to see which are divisible by 8. This second way involves fewer trials, and so is preferable.

Ask pupils to use one method or the other find the solution (144). Then ask:

Q Is this the only solution? How do you know? (we have worked systematically through all the possibilities)

Q What is the next multiple of 8 after 144? (152) **And the multiple of 8 before 144?** (136)

Write on the board $\square\square \times \square = 371$, or show the fifth problem on **OHT N5.6a**. Ask the class to explain the problem in their own words. Confirm that they are looking for a pair of factors of 371, one two-digit and one single-digit number, each of which divides exactly into 371.

Q How else could we write the equation? ($371 \div \square = \square\square$)

Q How could we begin to solve this problem?

Establish that they might consider the possibilities for the units digits.

Ask pupils to work in pairs to find a solution to the problem. When they have a solution ($53 \times 7 = 371$), invite a pair to the board to explain their method.

Q Is this the only solution? (yes)

Q How do you know? (the only possible pairs of units digits are 3 and 7, 1 and 1, or 9 and 9; $371 \div 3$ is too big, as is $371 \div 1$, and $371 \div 9$ is not a whole number)

Show the last problem on **OHT N5.6a**, $(1 + \square) \times \triangle = 100$. Explain that this time the boxes represent whole numbers not digits.

Q Explain the problem in your own words.

Remind the class that the contents of the brackets are worked out first. The sum of 1 and $\square$ is then multiplied by $\triangle$, to make a product of 100.

Q How can we tackle this problem? What information can we use?

Establish that $\triangle$ is a factor of 100, and that $(1 + \square)$ is the other factor, since factors occur in pairs. Draw the outline of a table on the board. Work through the pairs of factors of 100 and enter them into the table.

1 + □	△
100	1
50	2
25	4
20	5
10	10
5	20
4	25
2	50
1	100

Use the left-hand column to work out the possible values of □, and the nine possible solutions to the problem. Substitute a (□, △) pair into the original equation to check that the numbers work: (1 + 19) × 5 = 100.

other tasks

Springboard 7
Units 2 and 15

Unit 2 section 2: Multiplying and dividing by 10 and 100

Star challenge 3: × and ÷ problems page 73

Unit 15 section 6: Money and 'real life' problems

Star challenge 10: Clock sums page 493
Star challenge 11: Every which way you turn page 493
Star challenge 12: Number jigsaw page 494

plenary

Invite pairs of pupils to the board to demonstrate their solutions to the problems that they have worked on in the lesson.

Q Did anyone have a different way of tackling this problem?

Q Would your method be different if you had used a calculator?

Q Are there any other solutions?

Q How can you be sure that you have found all the solutions?

Remember

- When finding missing numbers, use the inverse operation to rewrite the equation.
- Look at the last digits to see if you can use your knowledge of number facts to eliminate possible values.
- Try out values that you can work out quickly in your head.
- Work systematically.

0.5	1.2	1.4	0.6	0.3

1.4	4.2	2.0
6.0	2.4	7.0
1.5	1.8	4.8

1.2	8.4	0.9
2.0	3.6	2.5
3.0	2.4	5.6

OHT N5.3a

1 A baker made 67 buns.
The baker packed the buns in boxes of 4.
How many boxes did the baker pack?

2 143 people are going to a wedding reception.
They will sit at tables for 6 people.
What is the least number of tables needed?

3 John spent £8.54 on 7 pens.
How much was each pen?

4 The Town Hall is 13.6 metres tall.
A model of it is one eighth of its size.
How tall is the model?

Resource N5.4a

1 A table is 200 centimetres long. How many metres is that?

2 Divide sixty-three by nine.

3 There were two hundred and fifty-five people in a cinema. Fifty-five were children. How many were not children?

4 Mari bought a car for one thousand pounds. Later she sold it for half that price. How much did she sell her car for?

5 A skirt cost thirty pounds. The price went up by ten per cent. What is the new price?

6 What is four point seven multiplied by one hundred?

7 A city has a population of seven million and forty-seven thousand. Write this number in figures.

8 What is the cost of five cassettes at one pound ninety-nine each?

9 Ten per cent of a number is thirteen. What is the number?

10 The temperature in a freezer was minus eighteen degrees Celsius. The temperature rose by five degrees. What was the new temperature inside the freezer?

11 What is the area of a rectangle of side lengths fifteen centimetres and three centimetres?

12 A television programme starts at seven thirty. It lasts one hundred minutes. At what time will it finish?

13 What is sixty per cent of forty pounds?

14 Multiply twelve by thirty.

15 What is seven hundred and thirty-two divided by one hundred?

OHT N5.5a

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He does 23 laps.

How much money does he raise?

b. Lynne wants to raise £100.
She is sponsored for £6.50 for each lap.

What is the least number of whole laps she must do?

2a. Some children go camping.
It costs £2.20 for each child to camp each night.
They go for 6 nights.

How much will each child have to pay for 6 nights?

b. There are 70 children.
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OHT N5.6a

Problem 1

I multiply my number by 27.
The product is 702.
What is my number?

Problem 2

1053 ÷ □ = 39

Problem 3

□ ÷ 19.2 = 14.5

Problem 4

□□ × 8 = 14□

Problem 5

□□ × □ = 371

Problem 6

(1 + □) × △ = 100