White Rose Maths

Summer - Block 1

Decimals

Overview

Small Steps

- Adding decimals within 1
- Subtracting decimals within 1
- Complements to 1
- Adding decimals – crossing the whole
- Adding decimals with the same number of decimal places
- Subtracting decimals with the same number of decimal places
- Adding decimals with a different number of decimal places
- Subtracting decimals with a different number of decimal places
- Adding and subtracting wholes and decimals
- Decimal sequences
- Multiplying decimals by 10, 100 and 1,000
- Dividing decimals by 10, 100 and 1,000

Notes for 2020/21

This block follows on from learning on decimals in the spring term.

Note that the block has been pushed back to start in the second week of the summer term. This allows the first week to be used to ensure that children are confident in the decimals work they have covered previously.

Adding Decimals within 1

Notes and Guidance

Children add decimals within one whole. They use place value counters and place value charts to support adding decimals and understand what happens when we exchange between columns.

Children build on their understanding that 0.45 is 45 hundredths, children can use a hundred square to add decimals.

Mathematical Talk

What is the number represented on the place value chart? What digit changes when I add a hundredth?

How many hundredths can I add before the tenths place changes? Explain why.

How can the children shade in the hundred square to support their calculations?

Why does using column addition support adding decimals? What is the same and what is different?

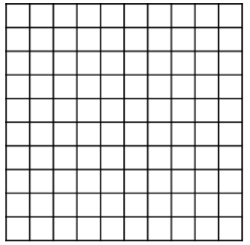
Varied Fluency

Use this place value chart to help answer the questions.

Ones	Tenths	Hundredths	Thousandths
	0.1 0.1 0.1 0.1	0.01	0.001 0.001

- What number is one hundredth more?
- Add 0.3, what number do you have now?
- How many more thousandths can I add before the hundredths digit changes?

Each box in this hundred square represents one hundredth of the whole. Use this to answer:



0.07 + 0.78

0.87 + 0.07

Use the column method to complete the additions.

0.45 + 0.5

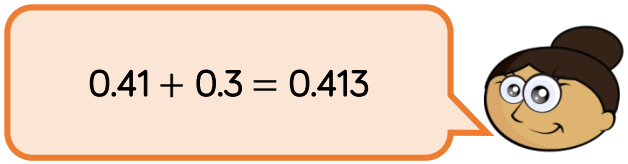
0.45 + 0.05

0.45 + 0.005

Adding Decimals within 1

Reasoning and Problem Solving

What mistake has Dora made?



Use at least 2 representations to show why she is incorrect.

Dora has put the 3 tenths in the thousandths place.

The correct answer is 0.71

Compare the numbers sentences using <, > or =

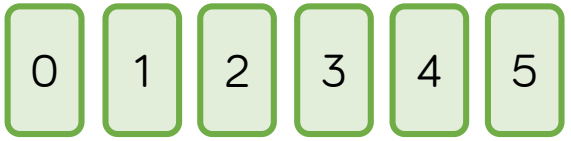
0.7 + 0.03 + 0.001 ◯ 0.07 + 0.3 + 0.1

0.4 + 0.1 + 0.05 ◯ 0.3 + 0.2 + 0.05

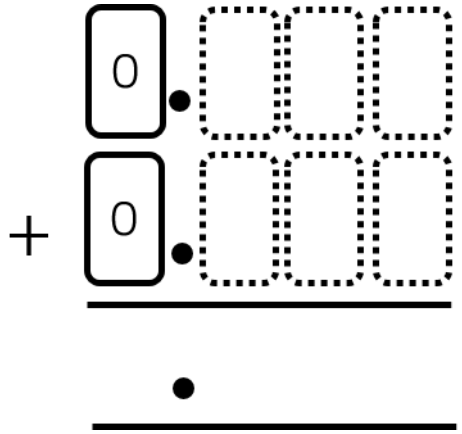
>

=

Rosie has some digit cards.



She uses each card once to make a number sentence.



What is the largest number she can make? What is the smallest?

Largest: 0.951

Smallest: 0.159

Subtracting Decimals within 1

Notes and Guidance

Children subtract decimals using a variety of different methods.

They look at subtracting using place value counters on a place value grid. Children also explore subtraction as difference by using a number line to count on from the smaller decimal to the larger decimal.

Children use their knowledge of exchange within whole numbers to subtract decimals efficiently.

Mathematical Talk

What is the number represented on the place value chart?

What is one tenth less than one?

What is one hundredth less than one?

Show me how you know.

If I'm taking away tenths, which digit will be affected? Is this always the case?

How many hundredths can I take away before the tenths place is affected?

Varied Fluency

Here is a number.

Ones	Tenths	Hundredths	Thousandths
	0.1 0.1 0.1	0.01 0.01 0.01 0.01	0.001 0.001 0.001 0.001

- What is three tenths less than the number?
- Take away 0.02, what is your number now?
- Subtract 5 thousandths. What is the final number?

Find the difference between the two numbers using the number line.

Calculate.

0.584 – 0.154 =
0.684 – 0.254 =
0.685 – 0.255 =

0.44 – 0.1 =
0.44 – 0.09 =
0.44 – 0.11 =

Subtracting Decimals within 1

Reasoning and Problem Solving

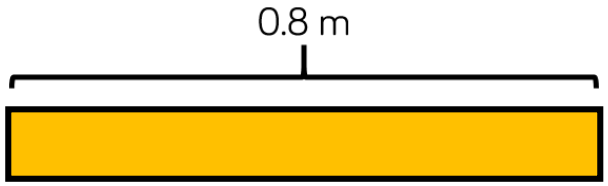
Here are four calculations.
Which one is the easiest to answer?
Which one is the trickiest to answer?
Explain your choice of order.

$0.45 - 0.3 =$
$0.45 - 0.15 =$
$0.45 - 0.23 =$
$0.45 - 0.18 =$

Children justify the order they have given.

Possible order:

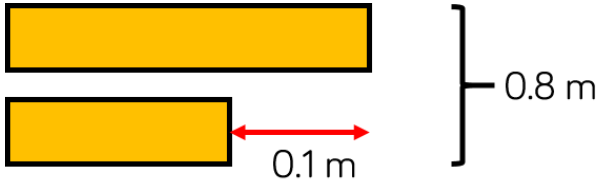
0.45 – 0.23 = 0.22
(no exchange)
0.45 – 0.15 = 0.3
(no exchange with 0)
0.45 – 0.3 = 0.15
(no exchange, different dp)
0.45 – 0.18 = 0.27
(exchange)



The strip of paper is 0.8 m long.

It is cut into two unequal parts.

The difference in lengths between the two strips of paper is 0.1 m



How long are the two strips of paper?

Strip 1: 0.45 m

Strip 2: 0.35 m

Complements to 1

Notes and Guidance

Children find the complements which sum to make 1

It is important for children to see the links with number bonds to 10, 100 and 1000

This will support them when finding complements to 1, up to three decimal places.

Children can use a hundred square, part-whole models and number lines to support finding complements to one.

Mathematical Talk

What number bonds can you use to help you?

How can shading the hundred square help you find the complement to 1?

How many different ways can you make 1? How many ways do you think there are?

If I add _____, which place will change? How many can I add to change the tenths/hundredths place?

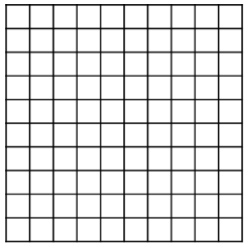
Varied Fluency

- Using a blank hundred square, where each square represents one hundredth, find the complements to 1 for these numbers.

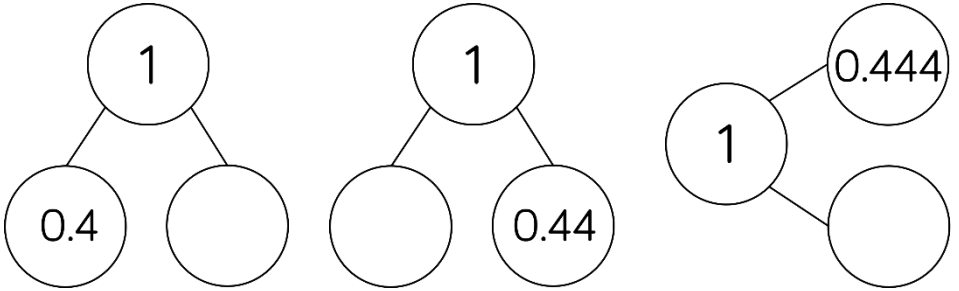
$0.55 + \square = 1$

$1 = 0.32 + \square$

$0.11 + 0.5 + \square = 1$



- Complete the part-whole models.



- Use the number line to find the complements to 1

0.324 ——————————————— 1

0.459 ——————————————— 1

Complements to 1

Reasoning and Problem Solving

$0.333 + \square = 1$

I think the answer is 0.777
because
0.3 + 0.7 = 1
0.03 + 0.07 = 0.1
0.003 + 0.007 = 0.01

Do you agree with Tommy?
Can you explain what his mistake was?

Tommy has forgotten that when you have ten in a place value column you need to use your rules of exchanging.

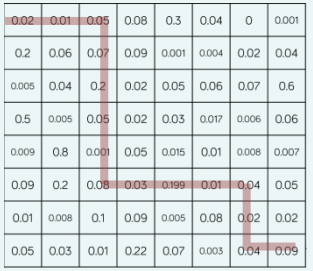
e.g.
10 tenths = 1 one
10 hundredths = 1 tenth
10 thousandths = 1 hundredth

The correct answer is 0.667

How many different ways can you find a path through the maze, adding each number at a time, to make a total of one?

Start →	0.02	0.01	0.05	0.08	0.3	0.04	0	0.001
	0.2	0.06	0.07	0.09	0.001	0.004	0.02	0.04
	0.005	0.04	0.2	0.02	0.05	0.06	0.07	0.6
	0.5	0.005	0.05	0.02	0.03	0.017	0.006	0.06
	0.009	0.8	0.001	0.05	0.015	0.01	0.008	0.007
	0.09	0.2	0.08	0.03	0.199	0.01	0.04	0.05
	0.01	0.008	0.1	0.09	0.005	0.08	0.02	0.02
	0.05	0.03	0.01	0.22	0.07	0.003	0.04	0.09 → 1

Once you have found a way, can you design your own smaller maze for others to solve?



Adding – Crossing the Whole

Notes and Guidance

Children use their skills at finding complements to 1 to support their thinking when crossing the whole. Children require flexibility at partitioning decimals, as bridging will be extremely important. Encourage children to make one first, then add the remaining decimal.

For example: 0.74 + 0.48 =

0.74 + 0.26 + 0.22 = 1.22

Mathematical Talk

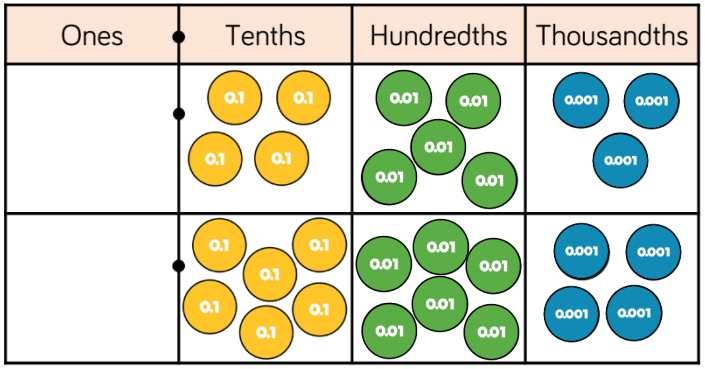
What happens when we have 10 in a place value column?

How would partitioning a number help us?
How do you decide what number to partition?
Why is partitioning 0.67 into 0.55 and 0.12 more helpful than 0.6 and 0.07?

What complement to 1 would I use to answer this question?

Varied Fluency

- Use the place value grid to answer 0.453 + 0.664



- Amir is using complements to 1 to add decimals.

0.45 + 0.67 =

0.55 + 0.12

0.45 + 0.55 + 0.12 = 1.12

Use Amir's method to solve:

a) 0.56 + 0.78
b) 3.42 + 0.79

- Use the column method to solve the additions.

0.47 + 0.6

0.982 + 0.18

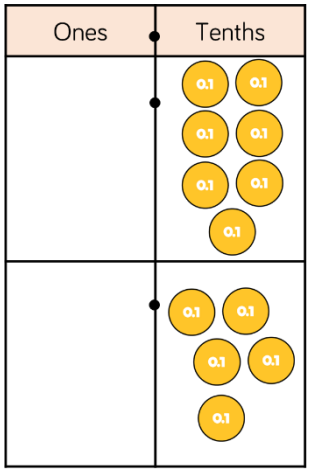
0.92 + 0.8

Adding – Crossing the Whole

Reasoning and Problem Solving

A place value grid is used to solve

0.7 + 0.5



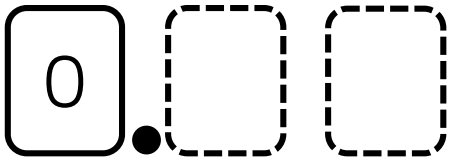
Alex thinks the answer is 0.12

What mistake has she made?

Ten lots of one tenth is one whole. There are 12 tenths so Alex needs to make an exchange. She should exchange 10 tenths for 1 one.

The correct answer is 1.2

You will need a partner and a six-sided dice for this game.



Take it in turns rolling the dice twice and placing the digits in the blank spaces above. Record the number in a table.

Swap over with your partner.

Roll the dice again and add your new number to the first number. The winner is the person who after adding 4 numbers is the closest to 1.5 **without** going over.

Example:

Player 1 rolls a 1 and a 4. 0.14

Player 1 then rolls a 2 and a 6. 0.26

0.14 + 0.26 = 0.38

Player 1	Player 2
0.14	0.64
0.38	1.23
0.69	1.49
1.24	~~1.60~~

Adding – Same Decimal Places

Notes and Guidance

Children add numbers greater than one with the same number of decimal places.

Place value grids and counters are extremely helpful in ensuring children are understanding the value of each digit and understanding when to exchange.

Ensure children see the formal written method (column addition) alongside the place value chart.

Mathematical Talk

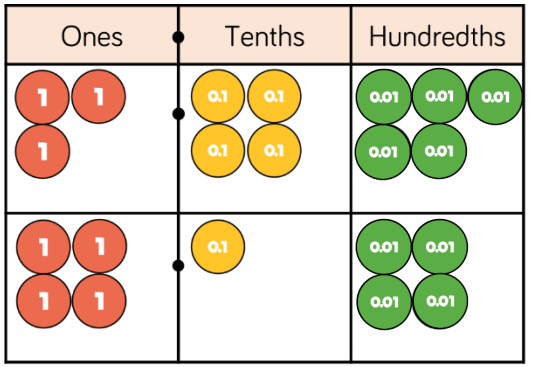
Why is it important to line up the columns?

What happens when there are a total of ten counters in a place value column?

Why is the position of the decimal point important?

Varied Fluency

- Use the place value chart to add 3.45 and 4.14



$$\begin{array}{r} 3.45 \\ +\ 4.14 \\ \hline \\ \hline \end{array}$$

- Use the column method to solve these additions.

$$\begin{array}{r} 4.42 \\ +\ 7.63 \\ \hline \\ \hline \end{array} \qquad \begin{array}{r} 4.55 \\ +\ 3.07 \\ \hline \\ \hline \end{array}$$

- Ron goes to the shops. He buys 3 items. What is the most he could pay? What is the least he could pay?


£4.45

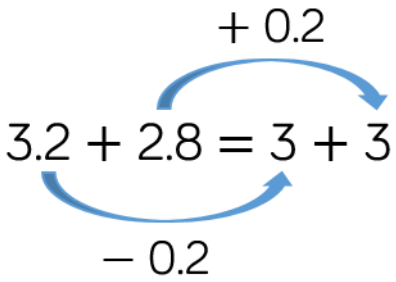

£5.59

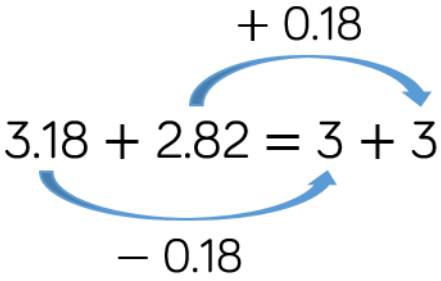

£3.99


£4.05

Adding – Same Decimal Places

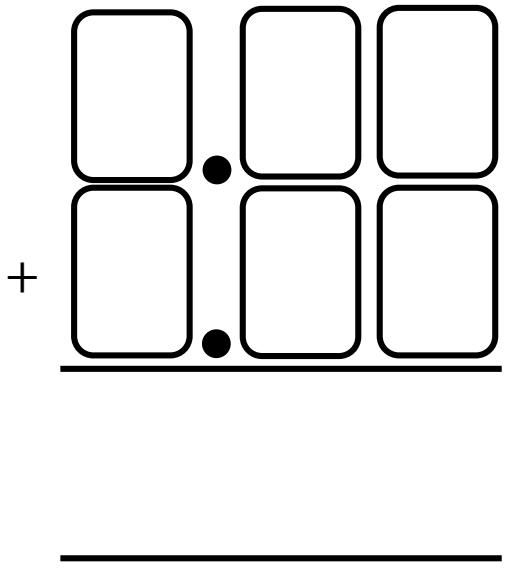
Reasoning and Problem Solving





Using these strategies, can you find more number sentences which have the same total as 3 + 3

Children may find a range of answers. The important teaching point is to highlight that you have added the same to one number as you have taken away from the other.



Using the digits 0 – 9 only once in each of the spaces above, what is:

- The largest sum possible
- The smallest sum possible

Is there more than one way of creating each total?

Largest

9.75 + 8.64

9.65 + 8.74

9.64 + 8.75

9.74 + 8.65

Smallest

0.24 + 1.35

0.25 + 1.34

0.34 + 1.25

0.35 + 1.24

Subtract – Same Decimal Places

Notes and Guidance

Children subtract numbers with the same number of decimal places. They use place value counters and a place value grid to support them with exchanging.

Children should be given opportunities to apply subtraction to real life contexts which could involve measures. Bar models can be a useful representation of the problems.

Mathematical Talk

What happens when you need to subtract a greater digit from a smaller digit e.g. 3 hundredths subtract 4 hundredths?

How many tenths are equivalent to one hundredth?

Do we only ever make one exchange in a subtraction calculation?

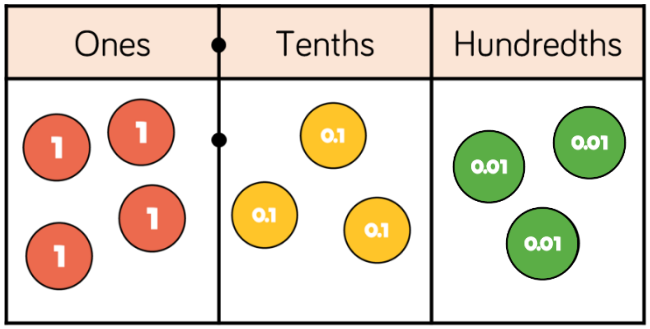
Which of these numbers will need exchanging?

Can you predict what the answer might be?

How could you check your answer?

Varied Fluency

Use the place value chart to find the to answer 4.33 – 2.14



$$\begin{array}{r} 4.33 \\ -\ 2.14 \\ \hline \\ \hline \end{array}$$

Use the column method to answer these questions.

$$\begin{array}{r} 6.4 \\ -\ 3.8 \\ \hline \\ \hline \end{array} \qquad \begin{array}{r} 5.05 \\ -\ 2.15 \\ \hline \\ \hline \end{array}$$

Jack has £12.54 in his wallet.
He buys a football which costs £5.82

How much money does he have left?

Subtract – Same Decimal Places

Reasoning and Problem Solving

Dexter and Annie have some money.
Dexter has £3.45 more than Annie.

They have £12.45 altogether.

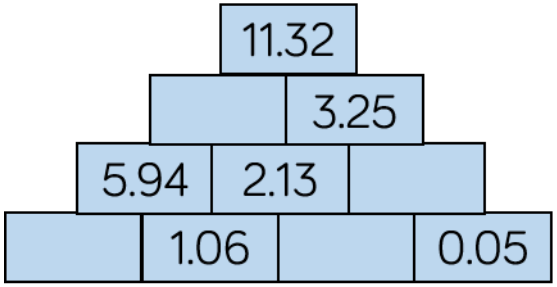
How much money does Annie have?

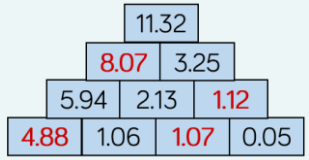
Dexter

Annie

Annie has £4.50

In this number pyramid, each number is calculated by adding the two numbers underneath.





Adding – Different D.P.

Notes and Guidance

Children add numbers with different numbers of decimal places. They focus on the importance of lining up the decimal point in order to ensure correct place value.

Children should be encouraged to think about whether their answers are sensible. For example, when adding 1.3 to 1.32 and getting an answer 1.45, how do we know it is not a sensible answer? Discuss the importance of estimation.

Mathematical Talk

Why is the decimal point important when we are reading and writing a number?

What would a sensible estimate be?

Is this a sensible answer? Why/why not?

What advice would you give to someone that is struggling with recording their numbers in the correct place?

Varied Fluency

- Use the place value grid to add 1.3 and 3.52

Ones	Tenths	Hundredths
1	0.1 0.1 0.1	
1 1 1	0.1 0.1 0.1 0.1	0.01 0.01

$$\begin{array}{r} 1.3 \\ +\ 3.52 \\ \hline \\ \hline \end{array}$$

- Use the column method to answer these questions.

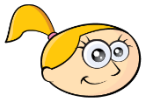
$$\begin{array}{r} 4.4 \\ +\ 7.044 \\ \hline \\ \hline \end{array} \qquad \begin{array}{r} 4.42 \\ +\ 1.6 \\ \hline \\ \hline \end{array}$$

- Whitney is cycling in a race.
  She has cycled 3.145 km so far and has 4.1 km left to go. What is the total distance of the race?

Adding – Different D.P.

Reasoning and Problem Solving

Eva is trying to find the answer to



4.144 + 1.4

Here is her working out.

$$\begin{array}{r} 4.144 \\ +\ \ 1.4 \\ \hline 4.248 \\ \hline \end{array}$$

Can you spot and explain her error?

Work out the correct answer.

The digits are lined up incorrectly.

Eva needs to line up the decimal point.

The correct answer is 5.544

Place the calculations in the correct column in the table.

9.99 + 0.1

9.99 + 1

9.99 + 0.001

9.99 + 0.01

Some calculations might need to go in more than one place.

No exchange	Exchange in the ones column	Exchange in the tenths column	Exchange in the hundredths column	Exchange in the thousandths column

Add 2 more calculations to each column.

No exchange:

9.99 + 0.001

Exchange in the ones column:

9.99 + 1

9.99 + 0.1

9.99 + 0.01

Exchange in the tenths column:

9.99 + 0.1

9.99 + 0.01

Exchange in the hundredths column:

9.99 + 0.01

Subtracting – Different D.P.

Notes and Guidance

Children subtract decimals with different numbers of decimal places.

They continue to focus on the importance of lining up the decimal point in order to ensure correct place value.

Children identify the importance of zero as a place holder.

Mathematical Talk

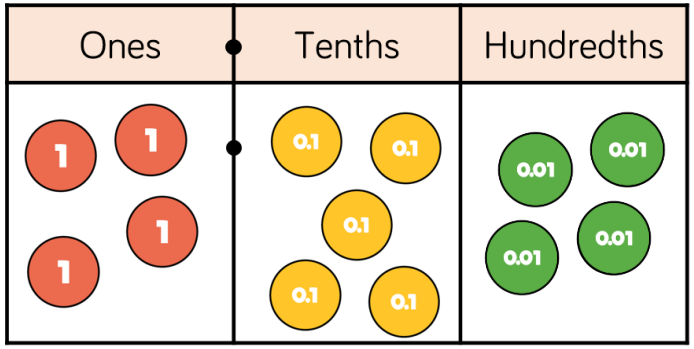
What does it mean if there is nothing in a place value column? How can we represent this in the formal written method?

What do you notice about 4.7 – 3.825 and 4.699 – 3.824? Is one of them more difficult than the other? Why?

Are there more efficient methods for this question?

Varied Fluency

Use the place value grid to help subtract 1.4 from 4.54



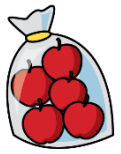
$$\begin{array}{r} 4.54 \\ -\ 1.4 \\ \hline \\ \hline \end{array}$$

Use the column method to work out the following.

$$\begin{array}{r} 6.06 \\ -\ 3.7 \\ \hline \\ \hline \end{array} \qquad \begin{array}{r} 4.7 \\ -\ 3.825 \\ \hline \\ \hline \end{array}$$

3.3 – 1.34 =
14.41 – 1.43 =
3 – 1.87 =

How much change would I get from £10 if I bought a bag of apples costing £4.27?



Subtracting – Different D.P.

Reasoning and Problem Solving

If there are 5 hundredths and I subtract nothing from it then there are still 5 hundredths.

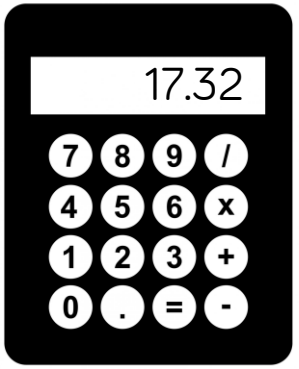
$$\begin{array}{r} 4.9 \\ -\ 3.85 \\ \hline 1.15 \\ \hline \end{array}$$

Do you agree with Whitney?
Explain your answer.

Whitney is not correct. She needs to use zero as a place value holder in the hundredths column of 4.9 and then exchange.

Encourage children to explore more efficient mental strategies as well as correcting the formal method.

The correct answer is 1.05



Teddy used a calculator to solve:
31.4 – 1.408

When he looked at his answer of 17.32 he realised he'd made a mistake.

He had typed all the correct digits in.

Can you spot his mistake?
What should the correct answer be?

Teddy placed the decimal point after the 4 making 14.08 instead of 1.408

The correct answer is 29.992

Wholes and Decimals

Notes and Guidance

Children add and subtract numbers with decimals from whole numbers. Highlight that whole numbers are written without a decimal point.

There may be a misconception when recording integers, link this to the place value grid. Emphasise prior understanding that the decimal point is to the right of the ones place.

Mathematical Talk

What is a whole number/integer?

Where can we add a decimal point to the number 143 so that its value stays the same?

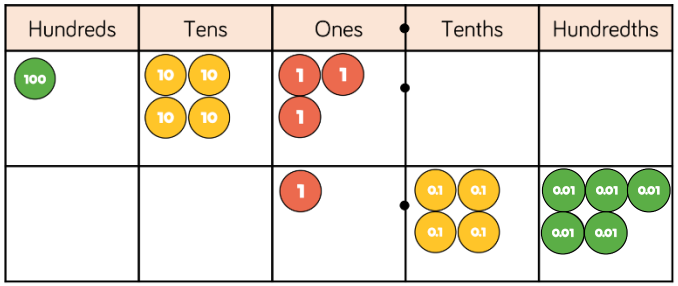
What's the same and what's different about 10 and 10.0 ?

Can you use different methods? (Number line, column subtraction, mentally).

Which is most efficient for this calculation? Explain why.

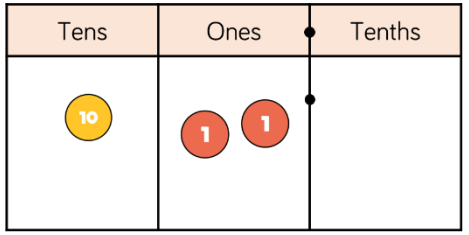
Varied Fluency

- Use the place value grid to help add 143 and 1.45



$$\begin{array}{r} 1\,4\,3\,. \\ +\quad 1\,.\,4\,5 \\ \hline \\ \hline \end{array}$$

- Use the place value grid to help work out 12 – 1.2



$$\begin{array}{r} 1\,2\,. \\ -\quad 1\,.\,2 \\ \hline \\ \hline \end{array}$$

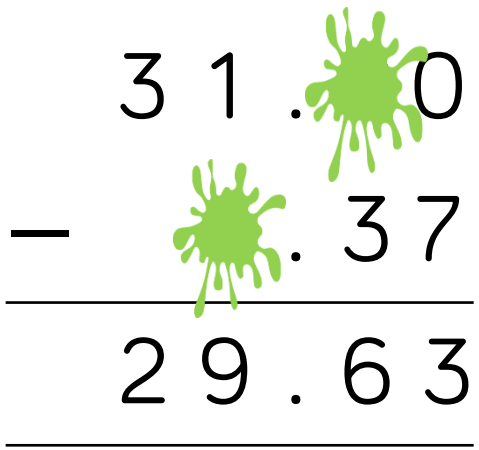
- Find the most efficient method to solve this calculations.

$43 - 2.14 + 0.86 =$	$19 - 0.25 =$
$23 + 4.105 =$	$19 - 17.37 =$

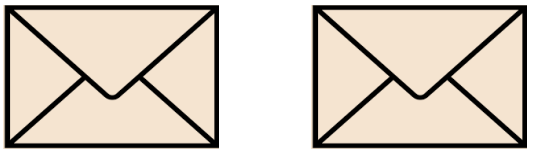
Wholes and Decimals

Reasoning and Problem Solving

What are the missing digits in the calculation?



31.00
– 1.37
29.63



Two envelopes contain two different numbers.

- The sum of the numbers is 9.92
- The difference between the numbers is 2.32

What numbers are inside the envelopes?

How can this bar model help?

3.8 and 6.12

Decimal Sequences

Notes and Guidance

Children look at decimal sequences and create simple rules, for example: adding 0.5 every time.

It is important to note that they are not expected to generate algebraic expressions for the sequences, but the use of the word 'term' could be used to predict the next number in the sequence. For example, what would be the value of the 10th term in the sequence?

Mathematical Talk

What do increasing and decreasing mean?

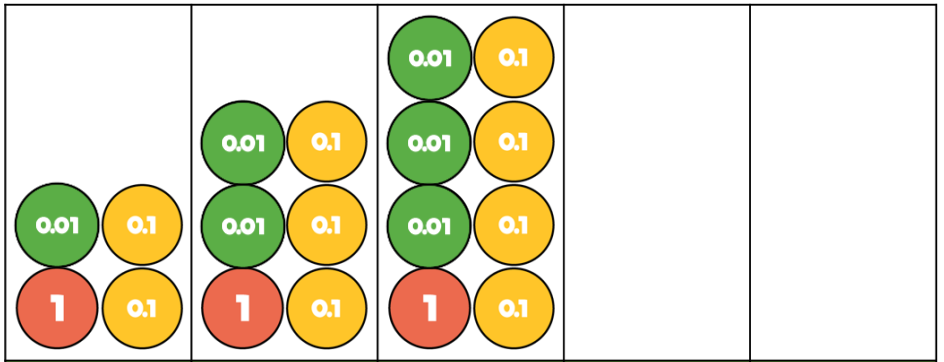
Is the sequence increasing by the same amount each time? By how much?

What is the same about each term? What is changing in each term?

What will the next term in the sequence be?

Varied Fluency

Complete the sequence.



1st	2nd	3rd	4th	5th
1.21	1.32	1.43		

Write the rules for each sequence.

- 0.45, 0.6, 0.75, 0.9 The rule is
- 1.25, 2.5, 3.75, 5, 6.25 The rule is

Generate the first 5 terms of this sequence.

The 1st term is 1.74
The sequence decreases by 0.24 each time.

Decimal Sequences

Reasoning and Problem Solving

9.48 9.52 9.56 9.6 ...

The number 9.7 will be in this sequence.

Do you agree with Jack?
Explain your answer.

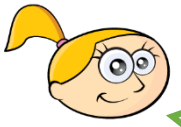
Jack is incorrect, 9.68 and 9.72 will be in the sequence but not 9.7

The terms are increasing by 0.04 therefore 9.7 will not be in the sequence.

	1st sequence	Relationship →	2nd sequence
1st term	0.1		1
2nd term	0.2		2
3rd term	0.3		3
4th term	0.4		4
5th term			

Eva compared the two sequences above. What do you notice about the differences between the terms in the two sequences?

Investigate Eva's sequences below and explain your thinking.



I wonder what the differences would be between sequences that go up in + 0.01 and +1 sequence...

The difference between the terms is increasing by 0.9 each time e.g.

1st + 0.9

2nd + 1.8

3rd + 2.7

4th + 3.6

Children may also notice that the terms in the 2nd sequence are ten times larger than in the first.

The differences would increase by 0.99 each time.

Multiply by 10, 100 and 1,000

Notes and Guidance

Children learn how to multiply numbers with decimals by 10, 100 and 1,000 They look at moving the counters in a place value grid to the left in order to multiply by multiples of 10 Children may have previously made the generalisation that when a number is ten times greater they put a zero on the end of the original number. This small step highlights the importance of understanding the effect of multiplying both integers and decimal numbers by multiples of 10.

Mathematical Talk

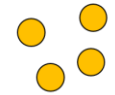
What is the value of each digit? Where would these digits move to if I multiplied the number by 10?

Why is the zero important in this number? Could we just take it out to make it easier for ourselves? Why/why not?

What do you notice about the numbers you are multiplying in the table?

Varied Fluency

Use the place value grid to multiply 3.24 by 10, 100 and 1,000

Thousands	Hundreds	Tens	Ones	Tenths	Hundredths
					

When you multiply by ____, you move the counters _____ places to the left.

Use a place value grid to multiply these decimals by 10, 100 and 1,000

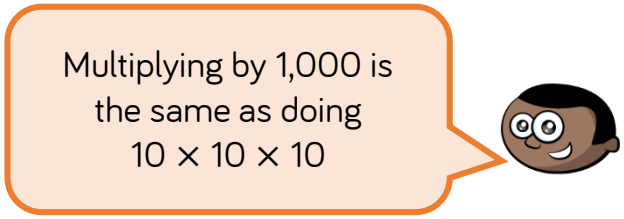
4.24 | 2.401 | 42.1

Complete the table below.

	×10	×100	×1,000
3.14			
13			
0.233			

Multiply by 10, 100 and 1,000

Reasoning and Problem Solving



Do you agree with Mo?
Explain your answer.

Mo is correct, as you move the digits 3 places to the left in both cases.

Using the digits 0-9 create a number with up to 3 decimal places, for example, 3.451

Cover the number using counters on your Gattegno chart.

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
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009

Explore what happens when you multiply your number by 10, then 100, then 1,000
What patterns do you notice?

Children will be able to see how the counter will move up a row for multiplying by 10, two rows for 100 and three rows for 1,000. They can see that this happens to each digit regardless of the value.

For example,

3.451 × 10 becomes 34.51

Each counter moves up a row but stays in the same column.

Divide by 10, 100 and 1,000

Notes and Guidance

Children learn how to divide numbers with decimals by 10, 100 and 1,000

Children use the place value chart to support the understanding of moving digits to the right.

Following on from the previous step, the importance of the place holder is highlighted.

Mathematical Talk

What is the value of each digit? Where would these digits move to if I divided the number by 10?

Which direction do I move the digits of the number when dividing by 10, 100 and 1,000?

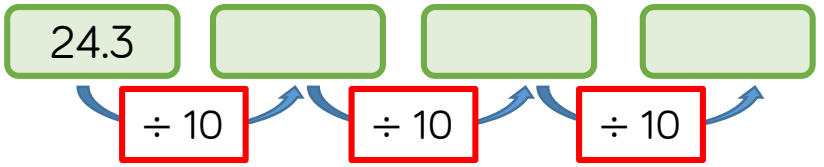
Varied Fluency

Use the place value grid to divide 14.4 by 10, 100 and 1,000

T	O	Tths	Hths	Thths	TThth
●	● ● ●	● ● ●			

When you divide by ____, you move the counters _____ places to the right.

Fill in the missing numbers in the diagram.



Fill in the missing numbers in these calculations.

34.2 ÷ ☐ = 0.342 ☐ ÷ 10 = 54.1

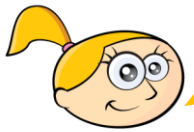
☐ ÷ 10 = 1.93 ÷ 100

Divide by 10, 100 and 1,000

Reasoning and Problem Solving

If you multiply a number by 1,000, you can just divide the answer by 1,000 to get back to your original number.

Whitney



That's not true, you would need to divide the answer by ten three times.

Eva

Who do you agree with?
Explain your thinking.

Both girls are correct, as dividing by 1,000 is the same as dividing by 10 three times.

Here are three rectangles.

The lengths of rectangle B are 10 times larger than rectangle A.
The lengths of rectangle C are 100 times smaller than rectangle B.

The perimeter of rectangle A is 1,000 times greater than the perimeter of rectangle C.

Do you agree with Mo?
Explain your thinking.

Mo is incorrect.

He has multiplied 10 and 100 to get 1,000 times greater.

The perimeter of rectangle A is only 10 times greater than rectangle C. Children may calculate the perimeters of each rectangle or may just notice the relationship between each.