BISHOP CHADWICK CATHOLIC EDUCATION TRUST

CALCULATION POLICY

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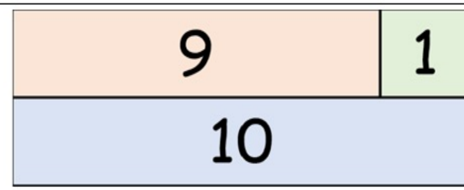
Number bonds of 5, 6, 7, 8, 9 and 10

Example – Some of the number bonds of 10

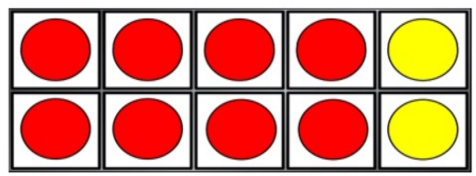
Concrete/Pictorial

Above we have 9 green cubes and 1 yellow cube which gives a total of 10 cubes.

Above we have 8 green cubes and 2 yellow cubes which gives a total of 10 cubes.



Above we have a part whole bar model which shows that 9 + 1 = 10 and 1 + 9 = 10



Above we have a tens frame with 8 red circles and 2 yellow circles which shows that 8 + 2 = 10 and

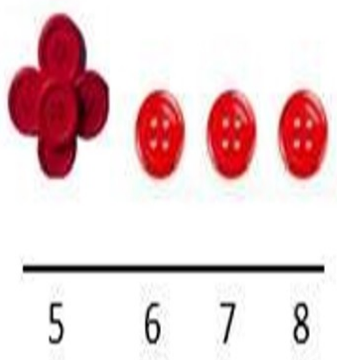
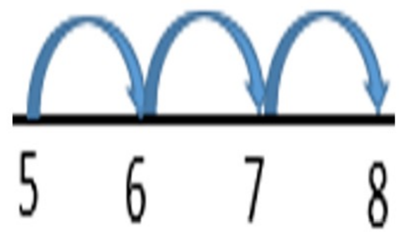
2 + 8 = 10

Abstract

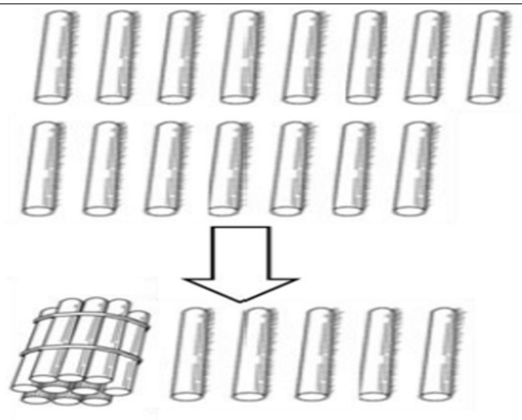
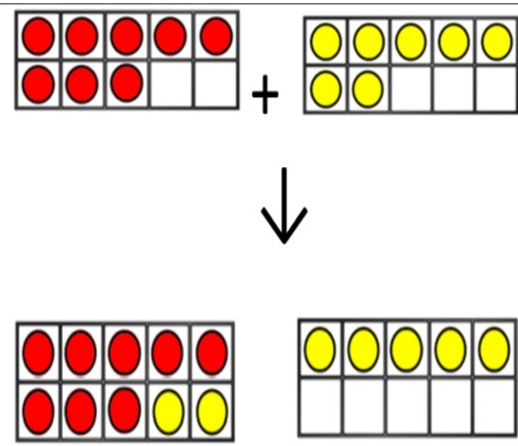
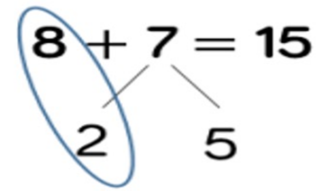
9 + 1 = 10 or 1 + 9 = 10

8 + 2 = 10 or 2 + 8 = 10

Counting

Example 5 + 3		
Concrete/Pictorial		**Abstract**
 Using the buttons above. Place the larger button at 5 on the number line and then place the 3 smaller buttons to the right. This takes you to 8 which is the answer.	 Using the number line above. Start at 5 and then count 3 places to the right which gives the answer 8.	$5 + 3 = 8$ Start at 5 and then count 3 places to the right which gives the answer 8.

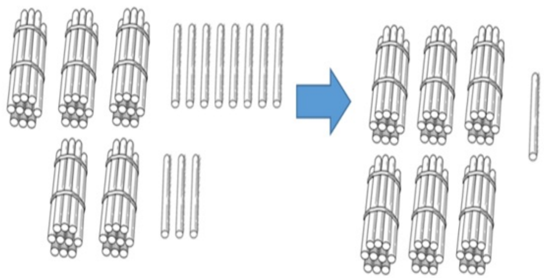
Adding 1-digit numbers by regrouping

Example 8 + 7		
Concrete/Pictorial		**Abstract**
 We are going to add together the 8 sticks in the first row with the 7 sticks in the second row by regrouping in tens. To do this, we take 2 of the sticks from the second row and place them with the 8 sticks in the first row. This makes 10 sticks which we have now put in a bundle on the left with 5 sticks left over. When we add these together we have 10 sticks + 5 sticks which gives a total of 15 sticks.	 We have 8 red counters placed in a tens frame and 7 yellow counters placed in a tens frame. We place 2 of the yellow counters in the top tens frame which gives a total of 10 counters (regrouping in tens). This leaves 5 yellow counters in the other tens frame. When we add these together we have 10 counters + 5 counters = 15 counters	 Start with the larger number 8. Split the smaller number 7 into 2 + 5 so that we can regroup in tens. Do 8 + 2 which gives 10. Then do 10 + 5 which gives the answer 15.

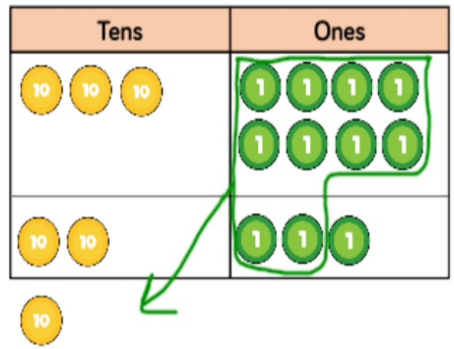
Adding 2-digit numbers using the column method

Example 38 + 23

Concrete/Pictorial

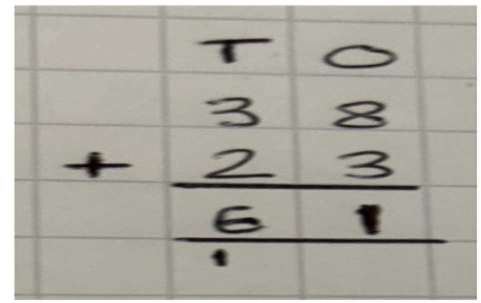


Represent the numbers using sticks.
For the 38 sticks, we have 3 bunches of 10 sticks and 8 single sticks. For the 23 sticks, we have 2 bunches of 10 sticks and 3 single sticks.
When we add the 8 and 3 single sticks, we have 11 single sticks. We exchange 10 of the 11 single sticks for 1 bunch of 10 sticks with 1 stick left over.
This gives us 6 bunches of 10 sticks and 1 single stick.
Therefore, the total number of sticks is 61.



Represent the numbers using the place value chart.
38 is represented by 3 tens and 8 ones.
23 is represented by 2 tens and 3 ones.
When we add the ones together, we get 11 ones.
We exchange 10 of the ones for 1 ten with 1 one left over.
This gives 6 tens and 1 one which gives a total 61.

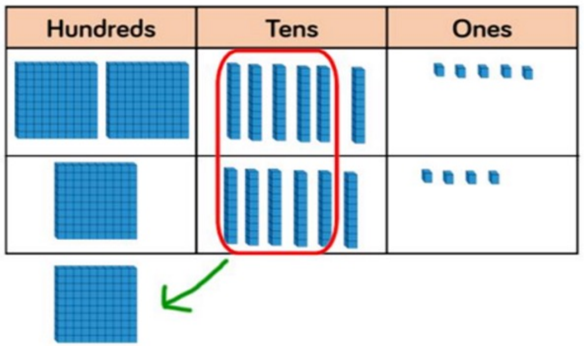
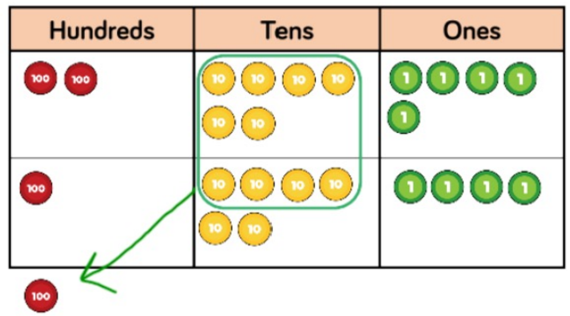
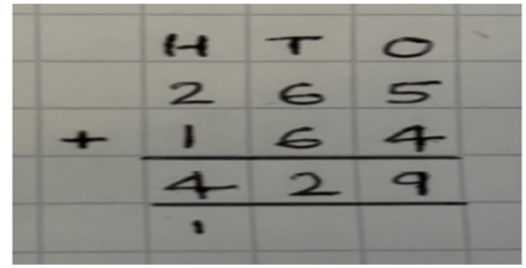
Abstract



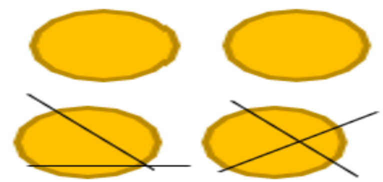
Line up the digits starting with the ones column on the right and then moving left to the tens column.
In the ones column, do 8 + 3 which equals 11 ones. Write 1 in the ones column and exchange the other 10 ones for 1 ten. Write this 1 ten at the bottom of the tens column.
In the tens column, do 3 tens + 2 tens + 1 ten = 6 tens = 60. This gives the final answer 61.

Adding 3-digit numbers using the column method

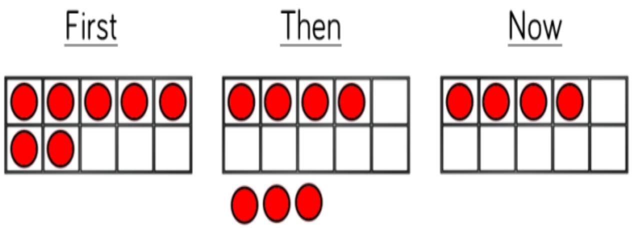
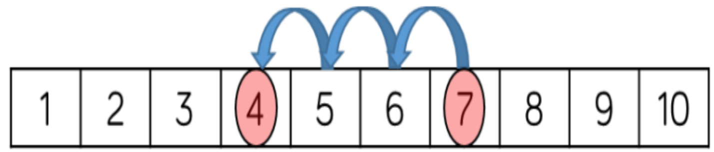
Example 265 + 164

Concrete/Pictorial		Abstract
 Represent the numbers using blocks in the place value chart. 265 is represented by 2 hundred blocks, 6 ten blocks and 5 one blocks. 164 is represented by 1 hundred block, 6 ten blocks and 4 one blocks. When we add the one blocks, we get 9 one blocks. When we add the ten blocks, we get 12 ten blocks. We exchange 10 ten blocks for 1 hundred block and place this in the hundred blocks column. The remaining 2 ten blocks stay in the ten blocks column. When we add the hundred blocks together, we get 4 hundred blocks. This gives the total 429.	 Represent the numbers using the place value chart. 265 is represented by 2 hundreds, 6 tens and 5 ones. 164 is represented by 1 hundred, 6 tens and 4 ones. When we add the ones together, we get 9 ones. When we add the tens together, we get 12 tens. We exchange 10 tens for 1 hundred and place this in the hundreds column. The remaining 2 tens stay in the tens column. When we add the hundreds together, we get 4 hundreds This gives the total 429.	 Line up the digits starting with the ones column on the right and then moving left to the tens and hundreds columns. In the ones column, do 5 + 4 which equals 9 ones. In the tens column, do 6 tens + 6 tens = 12 tens = 120. Write 2 in the tens column (for the 20) and exchange the other 10 tens for 1 hundred. Write this 1 hundred at the bottom of the hundreds column. In the hundreds column, do 2 hundreds + 1 hundred + 1 hundred = 4 hundreds = 400. This gives the final answer 429.

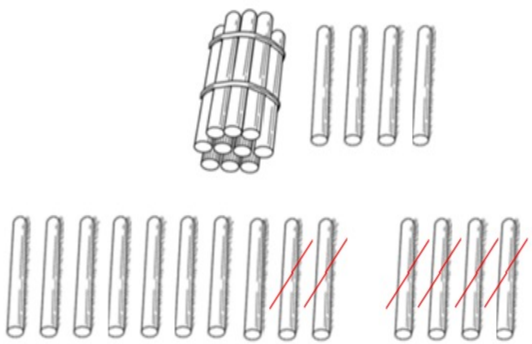
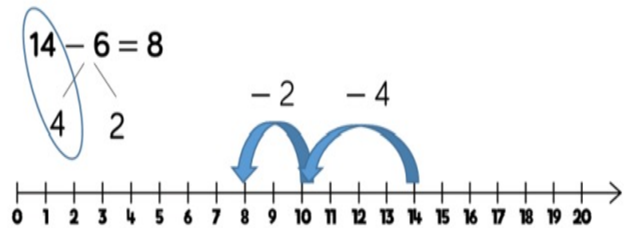
Subtracting ones

Example 4 – 2		
Concrete/Pictorial		Abstract
 Start with 4 cupcakes. If we take away (or eat?) 2 of the cupcakes this leaves we with 2 cupcakes.	 Start with 4 counters. If we take away 2 of the counters we are left with 2 counters.	$4 - 2 = 2$

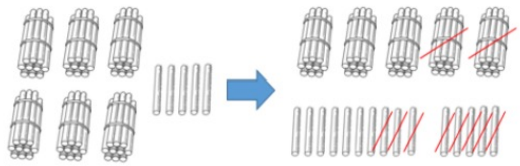
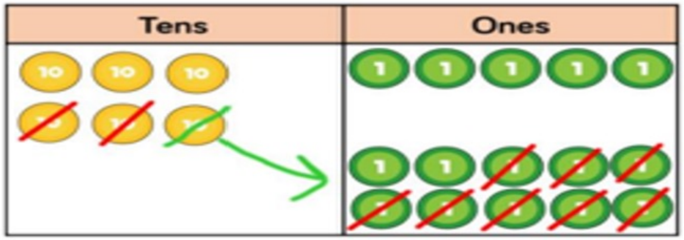
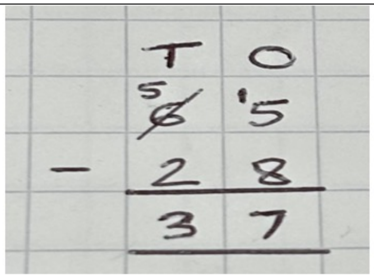
Counting back

Example 7 – 3		
Concrete/Pictorial		**Abstract**
 Represent 7 with the 7 circles on the left. Subtract 3 of the circles which leaves 4 circles.	 Using the number line above. Start at 7 and then count 3 places to the left which gives the answer 4.	$7 - 3 = 4$ Start at 7 and then count 3 places to the left which gives the answer 4.

Subtracting 1 and 2-digit numbers to 20

Example 14 – 6		
Concrete/Pictorial		Abstract
 For the 14 sticks, we have 1 bunch of 10 sticks and 4 single sticks. We untie the 1 bunch of 10 sticks so that we have 10 single sticks. We then subtract 6 single sticks which leaves us with 8 sticks.	 Using the number line above. Start at 14 and then count 4 places to the left which takes you to 10 and then count another 2 places to the left which takes you to 8. Alternatively, count 6 places to the left in one step to take you to 8.	$14 - 6 = 8$ Start at 14 and then count 6 places to the left which gives the answer 8.

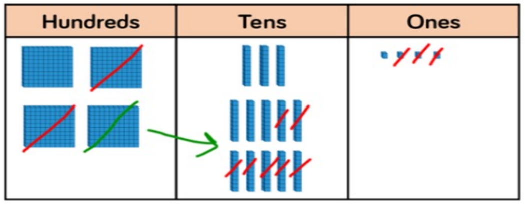
Subtracting 2-digit numbers using the column method

<table>
<tr><th colspan="3">Example 65 – 28</th></tr>
<tr><th colspan="2">Concrete/Pictorial</th><th>Abstract</th></tr>
<tr>
<td>
For the 65 sticks, we have 6 bunches of 10 sticks and 5 single sticks. So that we can subtract all the single sticks, we need to exchange 1 bunch of 10 sticks for 10 single sticks.
We can then subtract 28 sticks (2 bunches of 10 sticks and 8 single sticks) which leaves 37 sticks (3 bunches of 10 sticks and 7 single sticks).</td>
<td>
Represent 65 in the place value chart above as 6 tens and 5 ones. So that we can subtract all the ones, we need to exchange 1 of the tens for 10 ones.
We can then subtract 28 (2 tens and 8 ones) which leaves 3 tens and 7 ones to give the answer 37.</td>
<td>
Line up the digits starting with the ones column on the right and then moving left to the tens column.
In the ones column, we can’t subtract 8 from 5. Therefore, we exchange 1 of the tens from the tens column for 10 ones. We can then do 15 – 8 to give 7 ones.
In the tens column, we now have 5 tens – 2 tens = 3 tens = 30.
This gives the final answer 37.</td>
</tr>
</table>

Subtracting 3-digit numbers using the column method

Example 435 – 273

Concrete/Pictorial



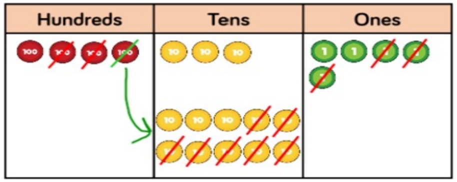
Represent 435 using diene blocks in the place value chart above. We have 4 hundred blocks, 3 ten blocks and 5 one blocks.

We can subtract 3 one blocks from the ones column to leave 2 one blocks.

So that we can subtract 7 ten blocks from the tens column, we need to exchange 1 of the hundred blocks in the hundreds column for 10 ten blocks. We can then subtract 7 ten blocks from 13 ten blocks to leave 6 ten blocks.

We can then subtract 2 hundred blocks from the hundreds column to leave 1 hundred block.

This gives the final answer 162.



Represent 435 in the place value chart above as 4 hundreds, 3 tens and 5 ones.

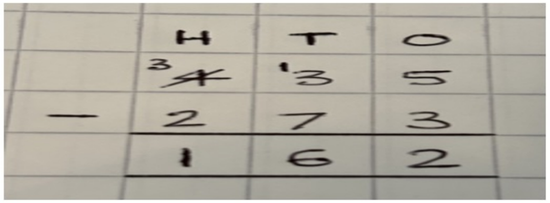
We can subtract 3 ones from the ones column to leave 2 ones.

So that we can subtract 7 tens from the tens column, we need to exchange 1 of the hundreds in the hundreds column for 10 tens. We can then subtract 7 tens from 13 tens to leave 6 tens.

We can then subtract 2 hundreds from the hundreds column to leave 1 hundred.

This gives the final answer 162.

Abstract



Line up the digits starting with the ones column on the right and then moving left to the tens and hundreds columns.

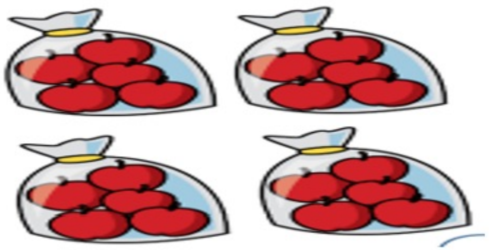
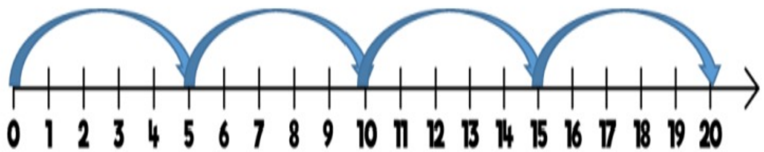
In the ones column, do 5 – 3 = 2 ones.

In the tens column, we can't subtract 7 tens from 3 tens. Therefore, we exchange 1 of the hundreds from the hundreds column for 10 tens. We can then do 13 tens – 7 tens = 6 tens = 60.

In the hundreds column, we now have 3 hundreds – 2 hundreds = 1 hundred = 100.

This gives the final answer 162.

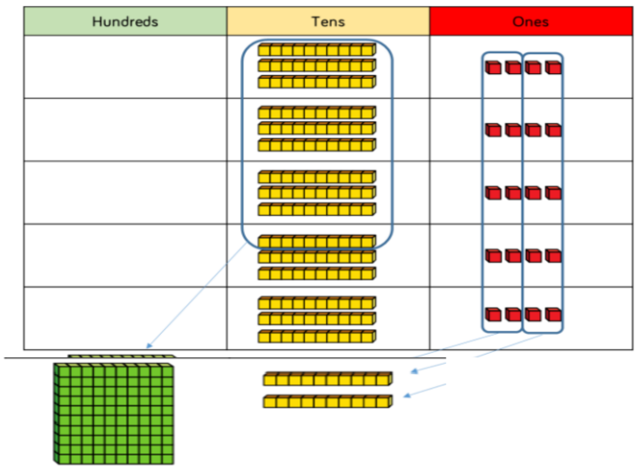
Multiplying 1-digit numbers

Example 4 x 5		
Concrete/Pictorial		**Abstract**
 Represent 4 x 5 with 4 bags each containing 5 apples. Calculate 4 lots of 5 or 5 + 5 + 5 + 5 both giving the answer 20.	 Represent 4 x 5 using the number line above. Calculate 4 lots of 5 or 5 + 5 + 5 + 5 both giving the answer 20.	4 x 5 = 20 Multiplication is commutative i.e. 4 x 5 = 5 x 4 = 20

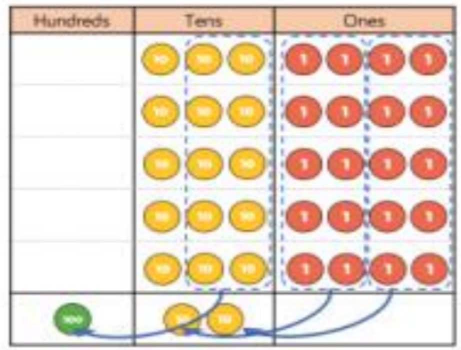
Multiplying a 2-digit number by a 1-digit number using the column method

Example 34 x 5

Concrete/Pictorial



Represent 34 x 5 using diene blocks in the place value chart above. We have 5 rows with 3 ten blocks and 4 one blocks in each row.
Start with the ones column by doing 5 x 4 one blocks = 20 one blocks. Exchange the 20 one blocks for 2 ten blocks. Write 0 in the ones column and put the 2 ten blocks at the bottom of the tens column.
Then we do 5 x 3 ten blocks + 2 ten blocks = 17 ten blocks. Exchange 10 ten blocks for 1 hundred block and put this 1 hundred block at the bottom of the hundreds column. Therefore we have 1 hundred block + 7 ten blocks which gives the final answer 170.



Represent 34 x 5 using the place value chart above. We have 5 rows with 3 tens and 4 ones in each row.
Start with the ones column by doing 5 x 4 ones = 20 ones. Exchange this 20 ones for 2 tens. Write 0 in the ones column and write 2 tens at the bottom of the tens column.
Then we do 5 x 3 tens + 2 tens = 17 tens.
Exchange 10 tens for 1 hundred so we have 1 hundred and 7 tens. Write 7 tens in the tens column and 1 hundred at the bottom of the hundreds column.
This gives the final answer 170.

Abstract

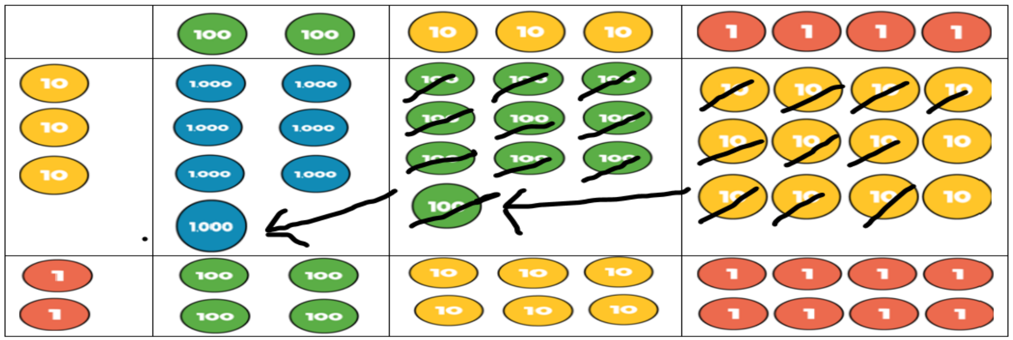
	H	T	O	
		3	4	
×			5	
	1	7	0	
	1	2		

Line up the digits starting with the ones column on the right and then moving left to the tens and hundreds columns.
Start by doing 5 ones x 4 ones = 20 ones.
Exchange this 20 ones for 2 tens. Write 0 in the ones column and write 2 tens at the bottom of the tens column.
Then we do 5 ones x 3 tens + 2 tens = 15 tens + 2 tens =17 tens. Exchange 10 tens for 1 hundred so we have 1 hundred and 7 tens. Write 7 tens in the tens column and 1 hundred at the bottom of the hundreds column.
Finally move the 1 hundred into the answer line so this gives the final answer 170.

Multiplying a 3-digit number by a 2-digit number using the column method

Example 234 x 32

Concrete/Pictorial



Represent the numbers 234 and 32 using the place value counters above. 234 = 2 hundreds + 3 tens + 4 ones and 34 = 3 tens + 2 ones.
So that the multiplications are in the same order as the column method we start with the bottom row.
2 ones x 4 ones = 8 ones, 2 ones x 3 tens = 2 x 30 = 60 = 6 tens and 2 ones x 2 hundreds = 2 x 200 = 400 = 4 hundreds. So this gives 468.
We then move to the top row.
3 tens x 4 ones = 30 x 4 = 120. We exchange the 120 for 1 hundred and 2 tens
We then do 3 tens x 3 tens = 30 x 30 = 900 = 9 hundreds. We then add on the 1 hundred already there which gives 10 hundreds. We exchange 10 hundreds for 1 thousand.
We then do 3 tens x 2 hundreds = 30 x 200 = 6000 = 6 thousands. We then add on the 1 thousand already in the thousands column to give 7 thousands. So this gives 7020.
We then add 468 and 7020 using the column method shown earlier which gives the answer 7488.

Abstract

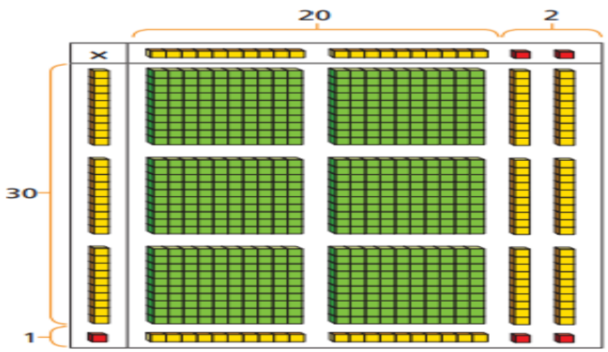
Th	H	T	O
	2	3	4
x		3	2
	4	6	8
$_1$7	$_1$0	2	0
7	4	8	8

Line up the digits starting with the ones column on the right and then moving left to the tens and hundreds columns.
Start by multiplying 234 by 2. This give 2 ones x 4 ones = 8 ones, 2 ones x 3 tens = 2 x 30 = 60 = 6 tens and 2 ones x 2 hundreds = 2 x 200 = 400 = 4 hundreds. So this gives 468.
We now multiply 234 by 30.
This gives 3 tens x 4 ones = 30 x 4 = 120. We exchange the 120 for 1 hundred, 2 tens and 0 ones. We write 0 in the ones column, 2 in the tens column and a small 1 in the hundreds column.
We then do 3 tens x 3 tens = 30 x 30 = 900 = 9 hundreds. We then add on the 1 hundred already in the hundreds column to give 10 hundreds. We exchange 10 hundreds for 1 thousand. We write 0 in the hundreds column and a small 1 in the thousands column.
We then do 3 tens x 2 hundreds = 30 x 200 = 6000 = 6 thousands. We then add on the 1 thousand already in the thousands column to give 7 thousands. So this gives 7020.
We then add 468 and 7020 using the column method shown earlier which gives the answer 7488.

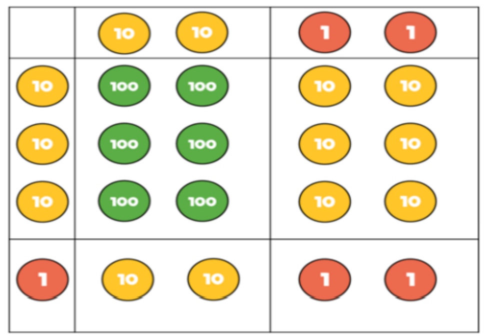
Multiplying a 2-digit number by a 2-digit number using the grid method

Example 22 x 31

Concrete/Pictorial



Represent the numbers 22 and 31 using the diene blocks. 22 = 2 ten blocks + 2 one blocks and 31 = 3 ten blocks + 1 one block.
We then do the multiplications.
2 ten blocks x 3 ten blocks = 20 x 30 = 600.
3 ten blocks x 2 one blocks = 30 x 2 = 60.
1 one block x 2 ten blocks = 1 x 20 = 20.
1 one block x 2 one blocks = 1 x 2 = 2.
We then add up these numbers using the column method shown earlier which gives the answer 682.



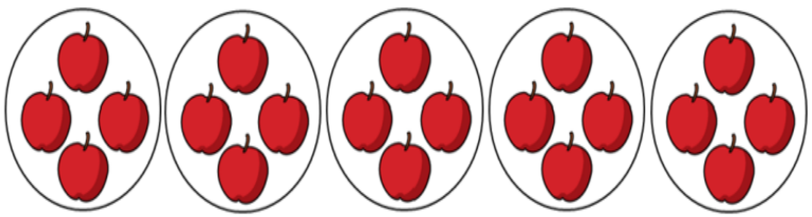
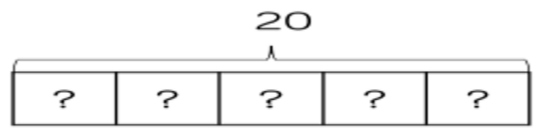
Represent the numbers 22 and 31 using the place value counters above. 22 = 2 tens + 2 ones and 31 = 3 tens + 1 one.
We then do the multiplications.
2 tens x 3 tens = 20 x 30 = 600.
3 tens x 2 ones = 30 x 2 = 60.
1 one x 2 tens = 1 x 20 = 20.
1 one x 2 ones = 1 x 2 = 2.
We then add up these numbers using the column method shown earlier which gives the answer 682.

Abstract

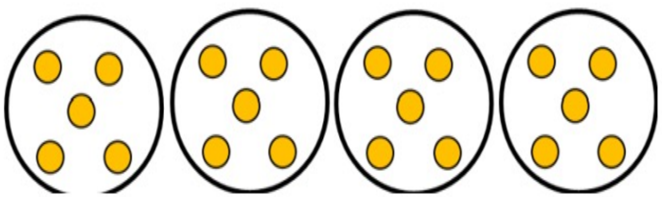
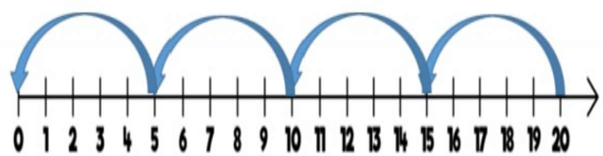
×	20	2
30	600	60
1	20	2

For the grid method, we partition both of the numbers so 20 = 20 + 2 and 30 = 30 +1 and set out the grid as above.
We then do the multiplications 30 x 20 = 600, 30 x 2 = 60, 1 x 20 = 20 and 1 x 2 = 2.
We then add up these numbers using the column method shown earlier which gives the answer 682.

Dividing by using the sharing method

Example 20 ÷ 5		
Concrete/Pictorial		**Abstract**
 Represent the division with 20 apples shared equally between 5 people. As can be seen above, each person would receive 4 apples	 Represent the division using the bar model above. The whole bar represents 20. If we split the bar into 5 equal parts then each part will be equal to 4.	**20 ÷ 5 = 4**

Dividing by using the grouping method

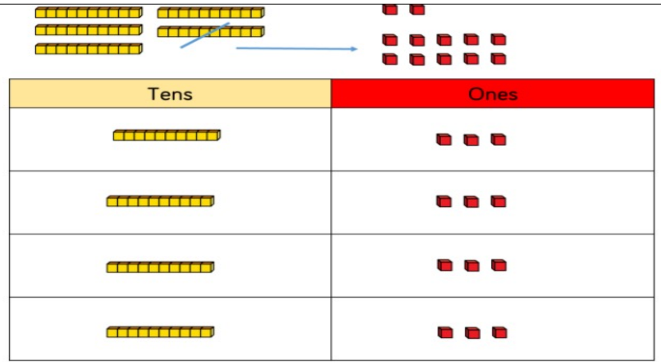
<table>
<tr><th colspan="3">Example 20 ÷ 5</th></tr>
<tr><th colspan="2">Concrete/Pictorial</th><th>Abstract</th></tr>
<tr>
<td>
Represent the division with 20 yellow counters placed into groups of 5. As can be seen above, this gives us 4 groups. Therefore, 20 ÷ 5 = 4.</td>
<td>

Represent the division on the number line above. We will start from 20 and need to work out the number of steps of 5 to get from 20 to 0 which is 4. Therefore 20 ÷ 5 = 4.</td>
<td>20 ÷ 5 = 4</td>
</tr>
</table>

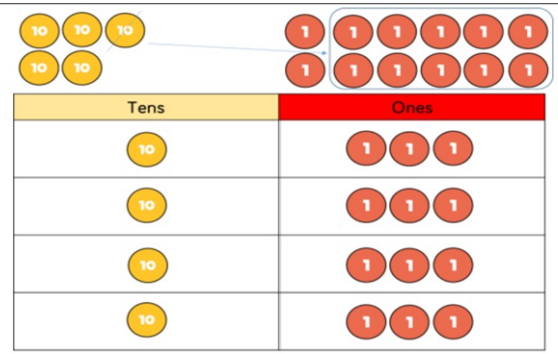
Dividing a 2-digit number by a 1-digit number using the sharing method

Example 52 ÷ 4

Concrete/Pictorial

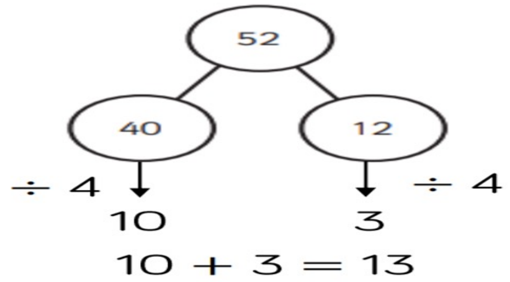


Represent 52 ÷ 4 using diene blocks in the place value chart above. The 5 ten blocks and 2 one blocks are initially at the top of the diagram.
We're going to share out the number into 4 equal rows.
We start by sharing the 5 ten blocks by 4 which gives us 1 ten block in each row with 1 ten block left over.
We exchange the 1 ten block left over for 10 one blocks (placed at the top). This now gives 12 one blocks.
We then share the 12 one blocks by 4 which gives us 3 one blocks in each row.
Therefore we have 1 ten block and 3 one blocks in each of the 4 rows so the answer is 13.



Represent 52 ÷ 4 using the place value chart above. The 5 tens and 2 ones are initially at the top of the diagram. We're going to share out the number into 4 equal rows.
We start by sharing the 5 tens by 4 which gives us 1 ten in each row with 1 ten left over. We exchange the 1 ten left over for 10 ones (placed at the top). This now gives 12 ones.
We then share the 12 ones by 4 which gives us 3 ones in each row.
Therefore we have 1 ten and 3 ones in each of the 4 rows so the answer is 13.

Abstract

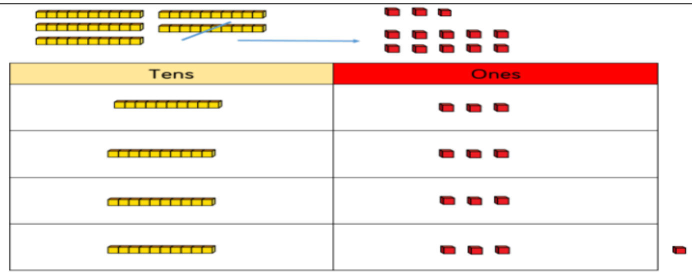


As can be seen above, we can split 52 into the sum of 2 numbers (40 and 12) which can both be shared exactly by 4.
40 ÷ 4 = 10
12 ÷ 4 = 3
Therefore, the final answer is 13.

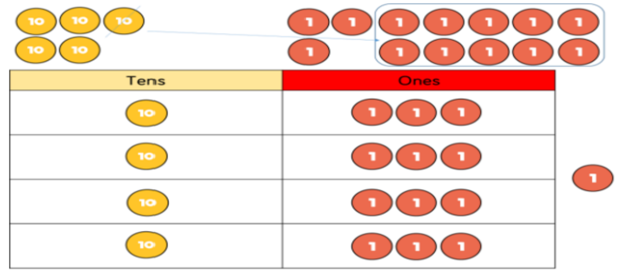
Dividing a 2 -digit number by a 1-digit number using the sharing method (with a remainder)

Example 53 ÷ 4

Concrete/Pictorial

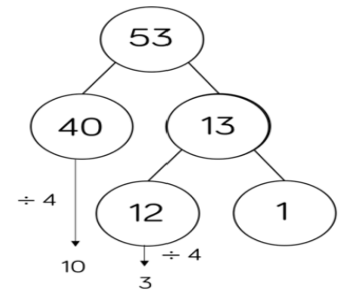


Represent 53 ÷ 4 using diene blocks in the place value chart above. The 5 ten blocks and 3 one blocks are initially at the top of the diagram.
We're going to share out the number into 4 equal rows.
We start by sharing the 5 ten blocks by 4 which gives us 1 ten block in each row with 1 ten block left over. We exchange the 1 ten block left over for 10 one blocks (placed at the top). This now gives 13 one blocks.
We then share the 13 one blocks by 4 which gives us 3 one blocks in each row with 1 one block left over.
Therefore we have 1 ten block and 3 one blocks in each of the 4 rows with 1 one left over. Therefore the answer is 13 rem 1.



Represent 53 ÷ 4 using the place value chart above. The 5 tens and 3 ones are initially at the top of the diagram.
We're going to share out the number into 4 equal rows.
We start by sharing the 5 tens by 4 which gives us 1 ten in each row with 1 ten left over. We exchange the 1 ten left over for 10 ones (placed at the top). This now gives 13 ones.
We then share the 13 ones by 4 which gives us 3 ones in each row with 1 one left over.
Therefore we have 1 ten and 3 ones in each of the 4 rows with 1 left over. Therefore the answer is 13 rem 1.

Abstract

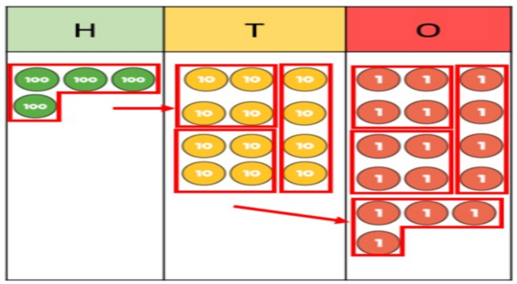


As can be seen above, we can split 53 into the sum of 2 numbers (40 and 13) where the 40 can be divided exactly by 4.
40 ÷ 4 = 10.
We then split 13 into the sum of 2 numbers (12 and 1) where 12 can be divided exactly by 4.
12 ÷ 4 = 3.
We have 1 left over.
Therefore, the final answer is 13 rem 1

Dividing a 3-digit number by a 1-digit number by short division using the grouping method

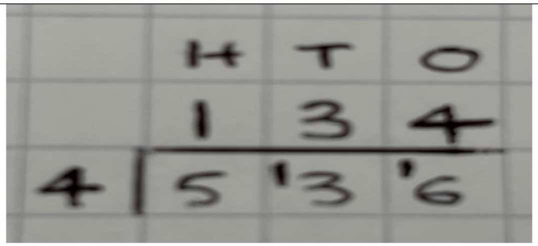
Example 536 ÷ 4	
Concrete/Pictorial	**Abstract**

Concrete/Pictorial



Represent 536 ÷ 4 in the place value chart above.
536 means 5 hundreds, 3 tens and 6 ones.
Start by dividing the 5 hundreds into groups of 4. As you can see we can make 1 group of 4 hundreds with 1 hundred left over. Exchange the 1 hundred left over for 10 tens. This now gives us 13 tens in the tens column.
We now divide the 13 tens into groups of 4. As you can see we can make 3 groups of 4 tens with 1 ten left over. Exchange the 1 ten left over for 10 ones. This now gives 16 ones in the ones column.
Finally we divide the 16 ones into groups of 4 ones which gives us 4 groups.
Therefore we have 1 group of 4 hundreds, 3 groups of 4 tens and 4 groups of 4 ones so the answer is 134.

Abstract



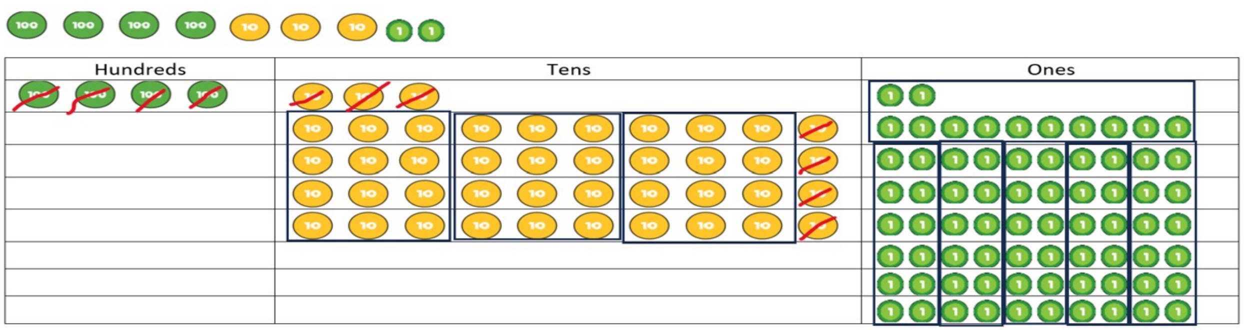
Represent 536 ÷ 4 as above often called the bus stop method.

Start by dividing the 5 hundreds into groups of 4. We can make 1 group of 4 hundreds with 1 hundred left over. Write the first 1 hundred in the hundreds column on the answer line and exchange the 1 hundred left over for 10 tens. This now gives us 13 tens in the tens column.
We now divide the 13 tens into groups of 4. We can make 3 groups of 4 tens with 1 ten left over. Write the first 3 tens in the tens column on the answer line and exchange the 1 ten left over for 10 ones. This now gives 16 ones in the ones column.
Finally we divide the 16 ones into groups of 4. We can make 4 groups of 4 ones which we write in the ones column on the answer line.
This gives the answer 134.

Dividing a 3-digit number by a 2-digit number by short division and using the grouping method

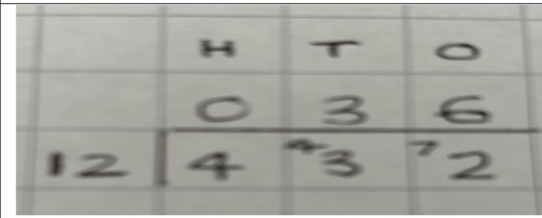
Example 432 ÷ 12

Concrete/Pictorial



Represent 432 in the place value chart above.
432 means 4 hundreds, 3 tens and 2 ones.
Start by trying to divide the 4 hundreds into groups of 12. As this can't be done, we exchange the 4 hundreds for 40 tens and place these in the tens column. We now have 43 tens in the tens column.
We now divide the 43 tens into groups of 12. We can make 3 groups of 12 tens with 7 tens left over. We exchange the 7 tens left over for 70 ones. This now gives 72 ones in the ones column.
Finally we divide the 72 ones into groups of 12. We can make 6 groups of 12 ones.
Therefore we have 3 groups of 12 tens and 6 groups of 12 ones which gives the answer 36.

Abstract

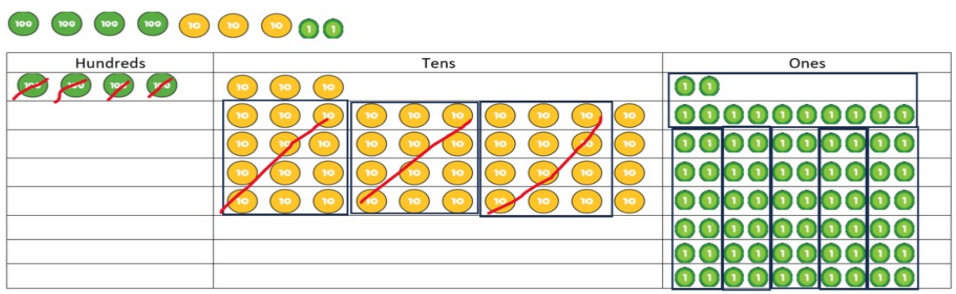


Represent 432 ÷ 12 as above often called the bus stop method.

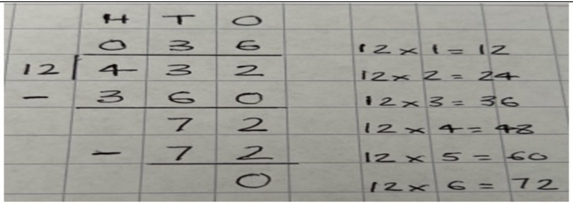
Start by trying to divide the 4 hundreds into groups of 12. As this can't be done, we write 0 in the hundreds column on the answer line and exchange the 4 hundreds for 40 tens and write this in the tens column. We now have 43 tens in the tens column.
We now divide the 43 tens into groups of 12. We can make 3 groups of 12 tens with 7 tens left over. Write the first 3 tens in the tens column on the answer line and exchange the 7 tens left over for 70 ones. This now gives 72 ones in the ones column.
Finally we divide the 72 ones into groups of 12. We can make 6 groups of 12 ones which we write in the ones column on the answer line.
This gives the answer 36.

Dividing a 3-digit number by a 2-digit number by long division and using the grouping method

Example 432 ÷ 12	
Concrete/Pictorial	**Abstract**

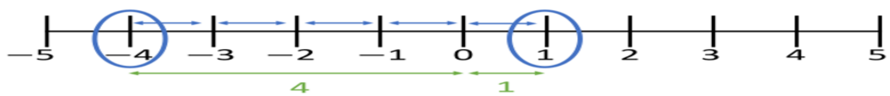
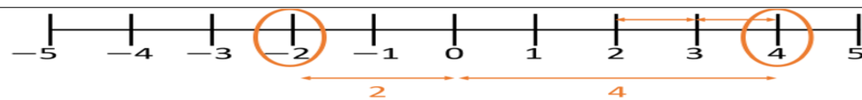
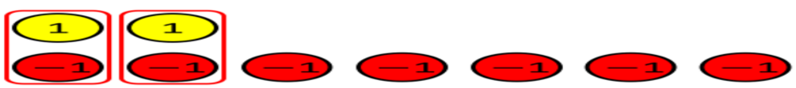
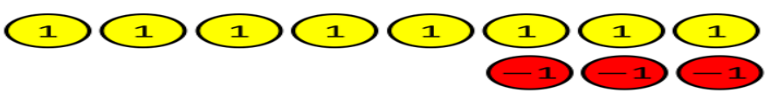


Represent 432 in the place value chart above. 432 means 4 hundreds, 3 tens and 2 ones.
Start by trying to divide the 4 hundreds into groups of 12. As this can't be done, we exchange the 4 hundreds for 40 tens so that we now have 43 tens in the tens column.
We now divide the 43 tens into groups of 12. We can make 3 groups of 12 tens which equals 36 tens = 360.
Our next step is to work out 432 – 360 which will tell us what we still need to divide by 12. If we cross out 36 tens (360) this leaves us with 7 tens and ones which is 72. As we can't divide 7 tens into groups of 12 we exchange the 7 tens for 70 ones so that we have 72 ones. We can make 6 groups of 12 ones.
This gives the answer 36.



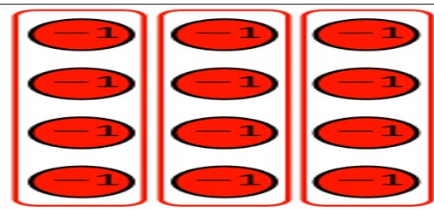
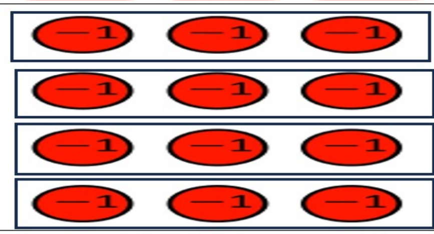
Start by trying to divide the 4 hundreds into groups of 12. As this can't be done, we write 0 in the hundreds column on the answer line and exchange the 4 hundreds for 40 tens so that we now have 43 tens in the tens column.
We now divide the 43 tens into groups of 12. We can make 3 groups of 12 tens. Write the 3 tens in the tens column on the answer line. We now work out 12 x 3 tens = 12 x 30 = 360 and write this underneath the 432.
Our next step is to work out 432 – 360 which will tell us what we still need to divide by 12. 432 – 360 = 72. 72 is 7 tens and 2 ones. As we can't divide 7 tens into groups of 12 we exchange the 7 tens for 70 ones so that we have 72 ones. We can make 6 groups of 12 ones. We write 6 ones in the ones column on the answer line. We now work out 6 x 12 ones = 6 x 12 = 72 and we write this underneath the 72. We then do 72 – 72 = 0. This means we have no more dividisions to do. This gives the answer 36.

Adding and subtracting positive and negative numbers

Concrete/Pictorial	Abstract
	$-4 + 5 = 1$ (4, 1) When you add a positive number, you move to the right on the number line. For this example, start at -4 and move 5 places right which gives the answer 1.
	$4 - 6 = -2$ (4, 2) When you subtract a positive number, you move to the left on the number line. For this example, start at 4 and move 6 places left which gives the answer -2.
 Represent 2 with 2 yellow positive counters and the -7 with 7 red negative counters. 1 yellow positive counter and 1 red negative counter makes a zero pair. We can therefore see that when we add the counters we get the answer -5.	**2 + -7** **= 2 – 7** **= -5** Adding a negative number is the same as subtracting. For this example, adding negative 7 is the same as subtracting 7.
 We start with 5 yellow positive counters. We need to subtract 3 red negative counters but we don't have any red negative counters. However, what we can do is add on 3 zero pairs as can be seen in the diagram. Now we can subtract -3 by taking away the 3 red negative counters which leaves us with 8 yellow positive counters so the answer is 8.	**5 - -3** **= 5 + 3** **= 8** Subtracting a negative number is the same as adding. For this example, subtracting negative 3 is the same as adding 3.

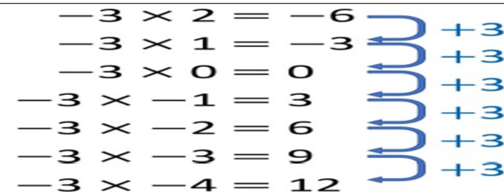
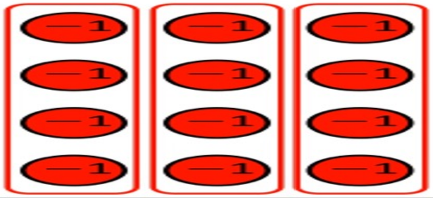
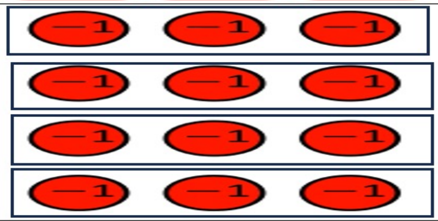
Multiplying positive and negative numbers

If the signs are the same, the answer is positive. If the signs are different, the answer is negative.

Concrete/Pictorial			Abstract
positive X positive = positive			**3 x 4 = 12**
positive X negative = negative		The diagram shows 3 columns of 4 red negative counters which gives a total of 12 red negative counters which gives the answer -12.	**3 x -4 = -12**
negative X positive = negative		The diagram shows 4 rows of 3 red negative counters which gives a total of 12 red negative counters which gives the answer -12.	**-3 x 4 = -12**
negative X negative = positive	−3 × 2 = −6 −3 × 1 = −3 +3 −3 × 0 = 0 +3 −3 × −1 = 3 +3 −3 × −2 = 6 +3 −3 × −3 = 9 +3 −3 × −4 = 12 +3	We know from above that negative number x positive number = negative number. If we follow the pattern on the left we can see that negative x negative must be positive and -3 x -4 = 12	**-3 x -4 = 12**

Dividing positive and negative numbers

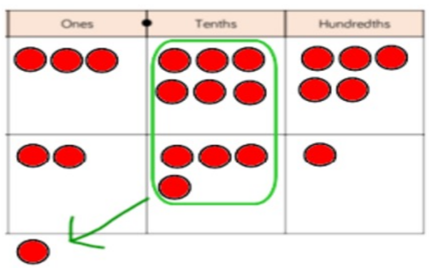
We know that multiplication and division are inverse operations. As with multiplication, If the signs are the same, the answer is positive and if the signs are different, the answer is negative.

Concrete/Pictorial		Abstract
positive ÷ positive = positive		As 3 x 4 = 12 12 ÷ 3 = 4
positive ÷ negative = negative		As -3 x -4 = 12 12 ÷ -3 = -4
negative ÷ positive = negative		As 3 x -4 = -12 -12 ÷ 3 = -4
negative ÷ negative = positive		As -3 x 4 = -12 -12 ÷ -3 = 4

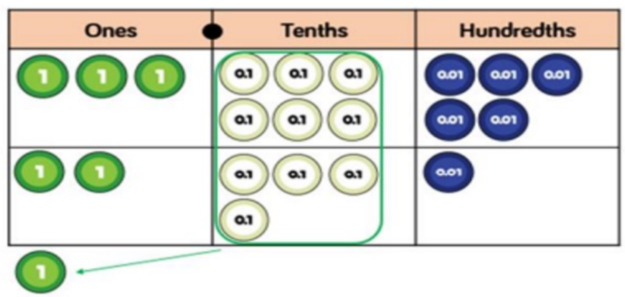
Adding decimal numbers up to 3 decimal places

Example 3·65 + 2·41

Concrete/Pictorial

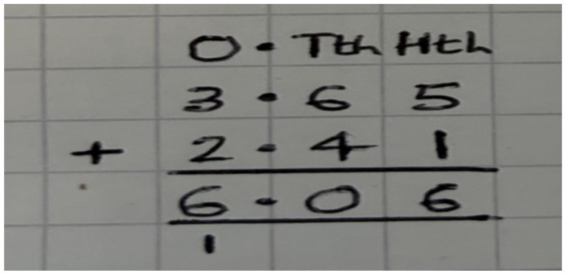


Represent the number using place value counters in a place value chart.
3·65 is represented by 3 ones, 6 tenths and 5 hundredths.
2·41 is represented by 2 ones, 4 tenths and 1 hundredth.
When we add the hundredths together, we get 6 hundredths (0·06).
When we add the tenths together, we get 10 tenths (same as 1 whole). Therefore, we exchange the 10 tenths for 1 whole.
When we add the ones together, we get 6.
This gives the final answer 6·06.



Represent the numbers using decimal place value counters in a place value chart.
3·65 is represented by 3 ones, 6 tenths (0·6) and 5 hundredths (0·05).
2·41 is represented by 2 ones, 4 tenths (0·4) and 1 hundredth (0·01).
When we add the hundredths together, we get 6 hundredths (0·06).
When we add the tenths together, we get 10 tenths (same as 1 whole). Therefore, we exchange the 10 tenths for 1 whole.
When we add the ones together, we get 6.
This gives the final answer 6·06.

Abstract

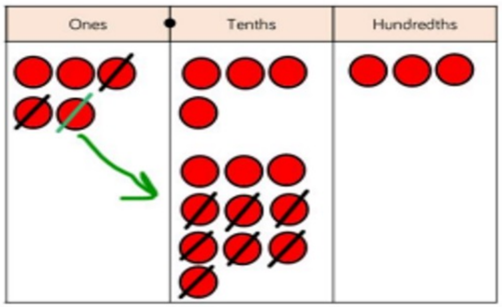


Line up the digits starting with the hundredths column on the right and moving left to the tenths and ones columns. Make sure that the decimal point lies between the ones and tenths columns.
In the hundredths column, do 5 hundredths + 1 hundredth = 6 hundredths.
In the tenths column, do 6 tenths + 4 tenths = 10 tenths. Exchange 10 tenths for 1 whole. Therefore, write 0 in the tenths column and 1 at the bottom of the ones column.
In the ones column, do 3 + 2 + 1 = 6.
This gives the final answer 6·06.

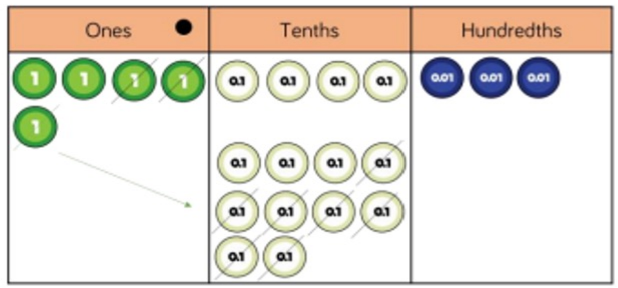
Subtracting decimal numbers up to 3 decimal places

Example 5·43 – 2·7

Concrete/Pictorial

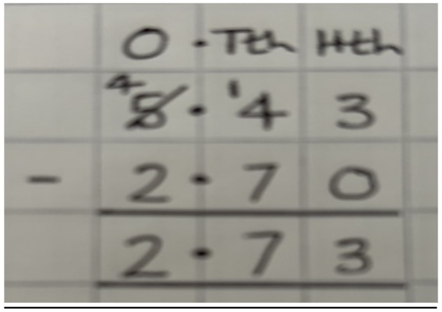


Represent 5·43 using place value counters in a place value chart.
So 5·43 is represented by 5 ones, 4 tenths and 3 hundredths.
In the hundredths column, 3 hundredths – 0 hundredths = 3 hundredths
In the tenths column, we can't subtract 7 tenths from 4 tenths. Therefore, we exchange 1 whole one for 10 tenths. We then do 14 tenths – 7 tenths = 7 tenths.
In the ones column, do 4 – 2 = 2 ones = 2
This gives the final answer 2·73.



Represent 5·43 using decimal place value counters in a place value chart.
So 5·43 is represented by 5 ones, 4 tenths (0·4) and 3 hundredths (0·03).
In the hundredths column, 3 hundredths – 0 hundredths = 3 hundredths = 0·03
In the tenths column, we can't subtract 7 tenths (0·7) from 4 tenths (0·4). Therefore, we exchange 1 whole one for 10 tenths. We then do 14 tenths (1·4) – 7 tenths (0·7) = 7 tenths (0·7)
In the ones column, do 4 – 2 = 2 ones = 2
This gives the final answer 2·73.

Abstract



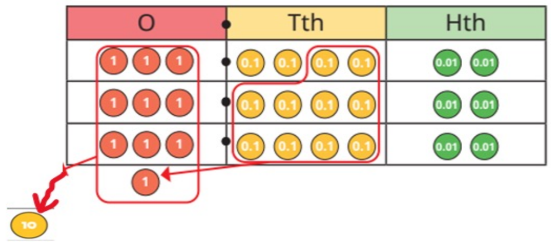
Line up the digits starting with the hundredths column on the right and moving left to the tenths and ones columns. Fill in any gaps with zeros. Make sure that the decimal point lies between the ones and tenths columns.
In the hundredths column, do 3 hundredths - 0 hundredths = 3 hundredths.
In the tenths column, we can't subtract 7 tenths from 4 tenths. Therefore, we exchange 1 whole one for 10 tenths. We then do 14 tenths – 7 tenths = 7 tenths.
In the ones column, do 4 – 2 = 2 ones = 2
This gives the final answer 2·73.

Multiplying decimal numbers by integers

Example 3·42 x 3

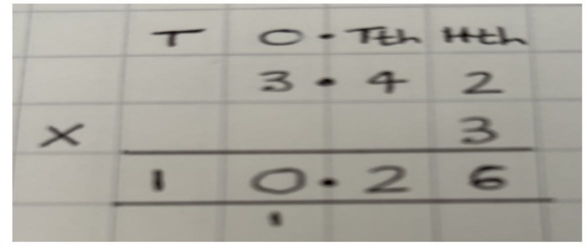
Concrete/Pictorial

Represent 3·42 x 3 using the coins above. Represent £3·42 with 3 £1 coins, 4 10p coins and 2 1p coins.
Start with the 1p coins by doing 3 x 2p = 6p = £0·06.
Then we do 3 x 40p = 120p. Write 20p (£0·20) in the 10p column and exchange the other 10 10p's for £1 and place this in the £1 column.
Finally we do 3 x £3 plus the £1 already in the column which equals £10.
This gives the answer £10·26.



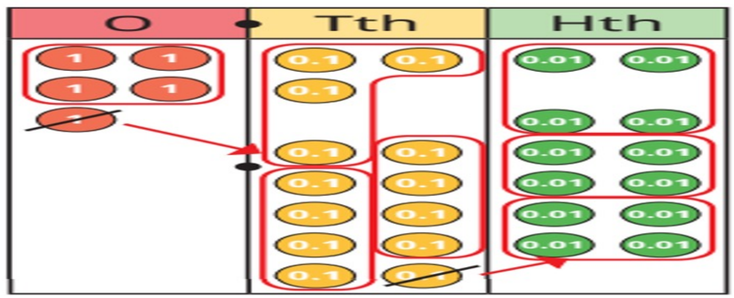
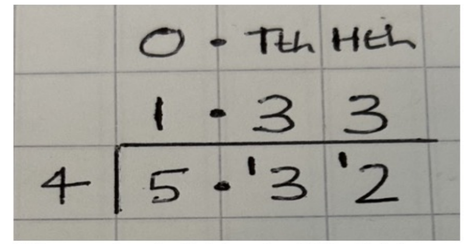
Represent 3·42 x 3 using the decimal place counters in the place value chart above. We have 3 rows with 3 ones, 4 tenths (0·4) and 2 hundredths (0·02) in each row.
Start with the hundredths column by doing 3 ones x 2 hundredths (0·02) = 6 hundredths = 0·06.
Then we do 3 ones x 4 tenths (0·4) = 12 tenths = 1·2. Write 2 tenths (0·2) in the tenths column and exchange the other 10 tenths for 1 whole one. We write this 1 at the the bottom of the ones column.
Finally we do 3 ones x 3 ones plus the 1 one already in the column which equals 10 ones.
Exchange the 10 ones for 1 ten. Write 0 in the ones column and 1 in the tens column.
This gives the answer 10·26.

Abstract



Line up the digits starting with the hundredths column on the right and moving left to the tenths, ones and tens columns.
Start by doing 3 ones x 2 hundredths = 6 hundredths = 0·06.
Then we do 3 ones x 4 tenths = 12 tenths. Write 2 tenths (0·2) in the tenths column and exchange the other 10 tenths for 1 whole one.
We write this 1 at the the bottom of the ones column.
Finally we do 3 ones x 3 ones plus the 1 one already in the column which equals 10 ones.
Exchange the 10 ones for 1 ten. Write 0 in the ones column and 1 in the tens column.
This gives the answer 10·26.

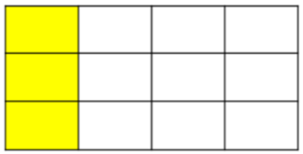
Dividing decimal numbers by integers

Example 5·32 ÷ 4		
Concrete/Pictorial		Abstract
 Represent £5·32 using the coins above so that we have 5 £1 coins, 3 10p coins and 2 1p coins. Start by working out how many groups of 4 £1 coins divide into £5 which is 1 with £1 left over. Exchange the £1 left over for 10 10p coins so we now have 13 10p coins. Then work out how many groups of 4 10p coins divide into 13 10p coins which is 3 with 1 10p coin left over. Exchange the 1 10p coin for 10 1p coins so we now have 12 1p coins. Finally work out how many groups of 4 1p coins divide into 12 1p coins which is 3. This gives the final answer £1·33.	 Represent 5·32 using decimal place value counters in the place value chart above. We have 5 ones, 3 tenths (0·3) and 2 thousandths (0·02). Start by working out how many groups of 4 ones divide into 5 ones which is 1 with 1 one left over. Exchange the 1 one left over for 10 tenths and place this in the tenths column so we now have 13 tenths. Then work out how many groups of 4 tenths divide into 13 tenths which is 3 with 1 tenth left over. Exchange the 1 tenth left over for 10 hundredths and place this in the hundredths column so we now have 12 hundredths. Finally work out how many groups of 4 hundredths divide into 12 hundredths which is 3. This gives the final answer 1·33.	 We use short division for this division. Start by working out how many groups of 4 ones divide into 5 ones which is 1 with 1 one left over. Write the first 1 one on the answer line and then exchange the 1 one left over for 10 tenths and place this in the tenths column so we now have 13 tenths. Then work out how many groups of 4 tenths divide into 13 tenths which is 3 with 1 tenth left over. Write the 3 tenths on the answer line and then exchange the 1 tenth left over for 10 hundredths and place this in the hundredths column so we now have 12 hundredths. Finally work out how many groups of 4 hundredths divide into 12 hundredths which is 3. Write the 3 hundredths on the answer line. This gives the final answer 1·33.

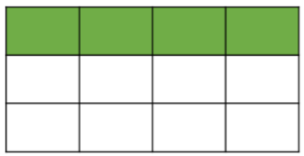
Adding fractions

Example $\frac{1}{4}+\frac{1}{3}$

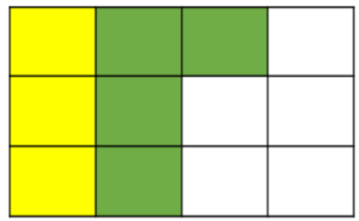
Concrete/Pictorial



$\frac{1}{4}$



$\frac{1}{3}$



$$\frac{1}{4}+\frac{1}{3}=\frac{7}{12}$$

We start by finding the smallest number that the denominators 4 and 3 divide into (called the lowest common multiple) which is 12. We use grids with 12 squares (3 squares by 4 squares) to represent both fractions. For $\frac{1}{4}$ we shade in 1 of the 4 columns which gives us 3 squares. For $\frac{1}{3}$ we shade in 1 of the 3 rows which gives us 4 squares. If we add those squares together in the final grid we can see that 7 of the 12 squares are shaded in which gives us the answer $\frac{7}{12}$.

Abstract

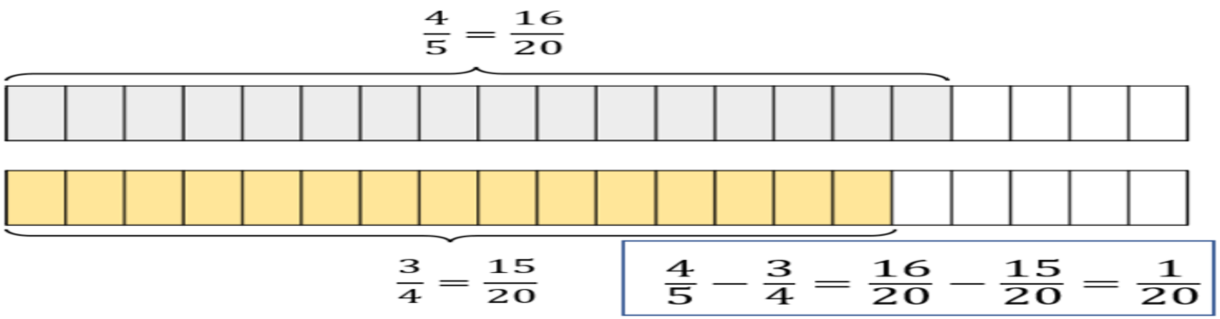
$$\frac{1}{4}+\frac{1}{3}=\frac{3}{12}+\frac{4}{12}=\frac{7}{12}$$

We start by finding the smallest number that the denominators 4 and 3 divide into (called the lowest common multiple) which is 12. We now write both of these fractions as equivalent fractions with denominator 12. For $\frac{1}{4}$ we need to multiply numerator and denominator by 3 which gives the equivalent fraction $\frac{3}{12}$. For $\frac{1}{3}$ we need to multiply numerator and denominator by 4 which gives the equivalent fraction $\frac{4}{12}$. Finally we add these 2 fractions together to give the answer $\frac{7}{12}$.

Subtracting fractions

Example $\frac{4}{5} - \frac{3}{4}$

Concrete/Pictorial



We start by finding the smallest number that the denominators 5 and 4 divide into (called the lowest common multiple) which is 20. We now write both of these fractions as equivalent fractions with denominator 20. For $\frac{4}{5}$ we need to multiply numerator and denominator by 4 which gives the equivalent fraction $\frac{16}{20}$. For $\frac{3}{4}$ we need to multiply numerator and denominator by 5 which gives the equivalent fraction $\frac{15}{20}$.

We use grids with 20 squares to represent both fractions. For $\frac{16}{20}$ we shade in 16 of the 20 squares and for $\frac{15}{20}$ we shade in 15 of the 20 squares. We can see that the difference between the 2 grids is $\frac{1}{20}$ which is our answer.

Abstract

$$\frac{4}{5} - \frac{3}{4} = \frac{16}{20} - \frac{15}{20} = \frac{1}{20}$$

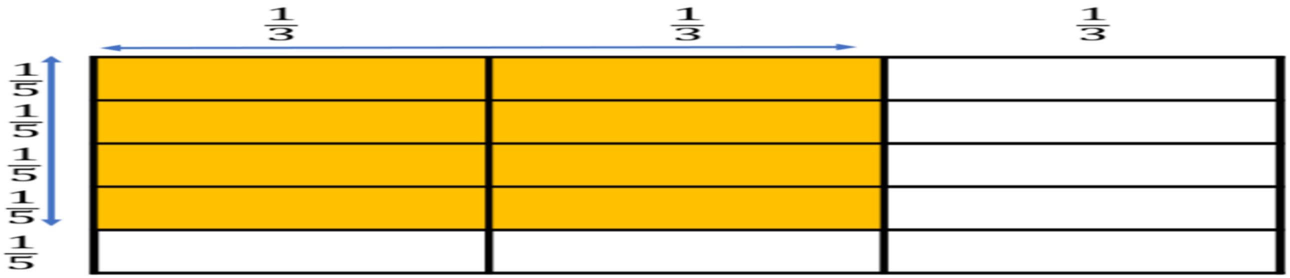
We start by finding the smallest number that the denominators 5 and 4 divide into (called the lowest common multiple) which is 20. We now write both of these fractions as equivalent fractions with denominator 20. For $\frac{4}{5}$ we need to multiply numerator and denominator by 4 which gives the equivalent fraction $\frac{16}{20}$. For $\frac{3}{4}$ we need to multiply numerator and denominator by 5 which gives the equivalent fraction $\frac{15}{20}$.

Finally we do $\frac{16}{20} - \frac{15}{20}$ to give the answer $\frac{1}{20}$.

Multiplying fractions

Example $\frac{4}{5} \times \frac{2}{3}$

Concrete/Pictorial



$\frac{4}{5} \times \frac{2}{3}$ means $\frac{4}{5}$ $\boldsymbol{of}$ $\frac{2}{3}$

Consider the 5 squares by 3 squares grid above which has 5 rows and 3 columns.

We will first of all shade in $\frac{2}{3}$ of the grid by shading in the first 2 of the 3 columns = 10 squares.

We then shade in $\frac{4}{5}$ of these 10 squares by shading in the top 4 out of the 5 rows = 8 squares.

As we have shaded in 8 out of the 15 squares then this gives us the answer $\frac{8}{15}$.

Abstract

$$\frac{4}{5} \times \frac{2}{3} = \frac{8}{15}$$

To multiply fractions, we need to multiply the numerators together and multiply the denominators together. 4 x 2 =8 and 5 x 3 = 15 which gives us the answer $\frac{8}{15}$

Dividing fractions

Example $3 \div \frac{1}{4}$

Concrete/Pictorial

1				1				1			
$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

Represent $3 \div \frac{1}{4}$ using the part whole bar model above.

Each whole bar on the top row is split into 4 quarters in the bottom row. We can see that 4 quarters divide into each whole one. Therefore, we can see that 12 quarters (3 x 4) divide into 3 whole ones. Therefore the answer is 12.

Abstract

$$3 \div \frac{1}{4}$$

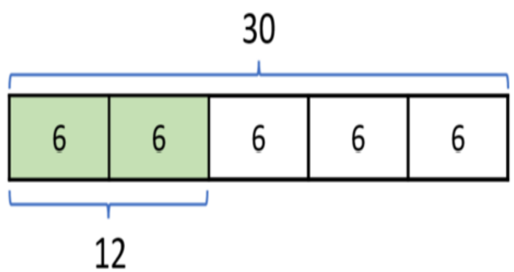
We can start by working out how many $\frac{1}{4}$ divide into 1 which is 4.

We can then work out how many $\frac{1}{4}$ divide into 3 by doing 3 x 4 which gives the answer 12.

A rule that you can use here is that dividing by a fraction is the same as multiplying by its reciprocal e.g.

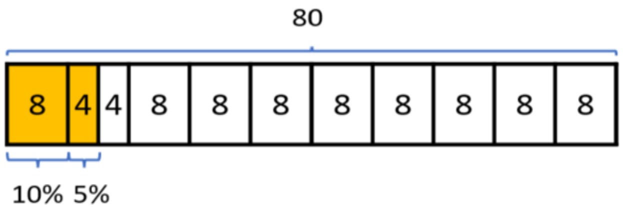
$$\frac{1}{5} \div \frac{2}{3} = \frac{1}{5} \times \frac{3}{2} = \frac{3}{10}$$

Finding a fraction of a quantity

Example $\frac{2}{5}$ **of 30**	
Concrete/Pictorial	**Abstract**
 Represent the number 30 using the bar model above. To work out $\frac{1}{5}$ of 30 we need to split the bar model into 5 equal parts. Each part is equal to 30 ÷ 5 = 6. For $\frac{2}{5}$ of 30 we need 2 of the 5 parts so we do 6 x 2 which gives us the answer 12.	**$\frac{2}{5}$ of 30** We first of all need to find $\frac{1}{5}$ of 30 by doing 30 ÷ 5 = 6. Then we find $\frac{2}{5}$ of 30 by doing 6 x 2 which gives us the answer 12.

Finding a percentage of a quantity

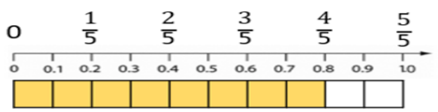
Examples   Find 15% of 80

Concrete/Pictorial	Abstract
 Represent 80 by the bar model above. Split the bar into 10 equal parts so each part represents 10%. Each 10% part is equal to 80 ÷ 10 = 8. We can find 5% by halving one of the 10% parts so ½ of 8 = 4. Therefore to find 15% we add together the 10% and 5% parts which is 8 + 4 = 12	**Find 15% of 80** 10% of 80 = 80 ÷ 10 = 8 5% of 80 = ½ of 8 = 4 15% of 80 = 8 + 4 = 12 Some other percentages that are useful to know are To find 50% of a quantity we divide by 2 To find 40% of a quantity we multiply 10% by 4 To find 1% of a quantity we divide by 100 To find 3% of a quantity we divide by 100 and multiply by 3

Converting a fraction into a decimal and a percentage

Example **Convert $\frac{4}{5}$ into a decimal and a percentage**

Concrete/Pictorial

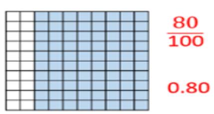


We represent $\frac{4}{5}$ on the 0 to 1 number line and bar model above.

Above the number line has been divided into 5 equal parts (fifths) and below the number line has been divided into 10 equal parts (tenths).

The bar model has also been divided into 10 equal parts.

We can see that $\frac{4}{5} = \frac{8}{10} = 0.8$



We represent $\frac{4}{5}$ using the hundred grid above. We know that $\frac{4}{5} = \frac{8}{10}$.

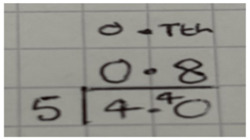
As can be seen 8 out of the 10 columns have been shaded in which is the same as 80 out of the 100 squares which is 80%

Abstract

Write $\frac{4}{5}$ as a decimal

The quickest way of converting $\frac{4}{5}$ into a decimal is to multiply the numerator and denominator by 2 which gives the equivalent fraction $\frac{8}{10}$ which is equal to 0·8.

$\frac{4}{5}$ also means 4÷5 so if we work this out using the bus stop method shown earlier we get



Start by working out how many groups of 5 ones divide into 4 ones. As this can't be done we write 0 in the ones column and exchange the 4 ones for 40 tenths and write this in the tenths column.

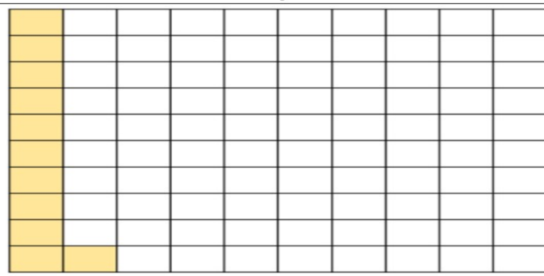
Then we work out how many groups of 5 tenths divide into 40 tenths which is 8 which we write in the tenths column on the answer line. This gives us the answer 0·8.

The quickest way of converting $\frac{4}{5}$ into a percentage is to multiply the numerator and denominator by 20 which gives the equivalent fraction $\frac{80}{100}$ which means 80 out of 100 which means 80%.

Converting a decimal into a fraction and a percentage

Example   Convert 0·11 into a fraction and a percentage

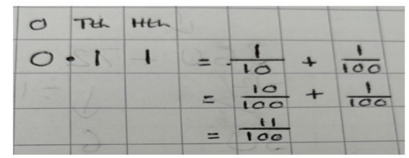
Concrete/Pictorial



Represent 0·11 using the 10 by 10 grid above.
We know that 0·11 = 0 ones + 1 tenth + 1 hundredth.
We can represent 1 tenth of the grid by shading in 1 of the 10 columns in the grid.
We can represent 1 hundredth of the grid by shading in 1 of the 100 squares in the grid.
Therefore we have shaded in 11 out of the 100 squares which means 0·11 = $\frac{11}{100}$ = 11%.

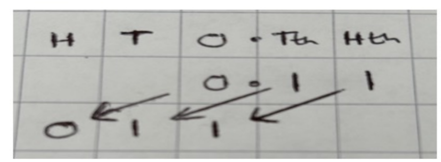
Abstract

Convert 0·11 into a fraction as shown below



Convert 0·11 into a percentage

To convert a decimal into a percentage we multiply by 100. When we multiply by 100 each of the digits should be multiplied by 100 so move 2 places to the left as we can see below.

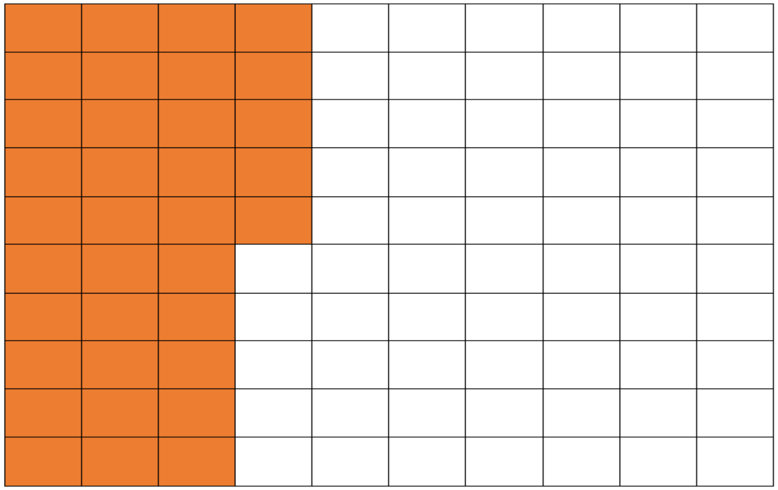


Therefore 0·11 = 11%

Converting a percentage into a decimal and a fraction

Example **Convert 35% into a decimal and a fraction**

Concrete/Pictorial

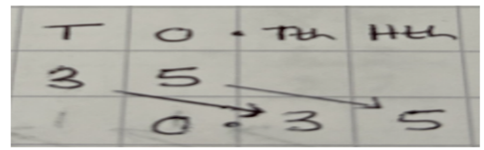


Represent 35% using the 10 by 10 grid above by shading 35 of the 100 squares.
Each column is equal to 0·1 of the whole grid. Half of each column is equal to 0·05. Therefore, as a decimal this gives 0·1 + 0·1 + 0·1 + 0·05 = 0·35.
We know that 35% means 35 out of 100 so we shade in 35 of the 100 squares. Therefore as a fraction this is $\frac{35}{100}$.
This can be simplified by dividing the numerator and denominator by 5 (called the highest common factor) which gives $\frac{7}{20}$.

Abstract

Convert 35% into a decimal

To convert a percentage into a decimal we divide by 100. When we divide by 100 each of the digits should be divided by 100 so move 2 places to the right as we can see below.



Therefore the answer is 0·35.

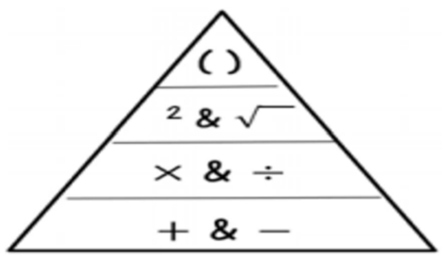
Convert 35% into a fraction

35% means 35 out of 100 so as a fraction this is $\frac{35}{100}$. This can be simplified by dividing the numerator and denominator by 5 (called the highest common factor) which gives $\frac{7}{20}$

Order of Operations (BIDMAS)

Example **$5 \times (6 - 2)^2$**

Concrete/Pictorial



Represent BIDMAS in the triangle above.

$5 \times (6 - 2)^2$
Do the bracket first
$= 5 \times 4^2$
Do the index number next
$= 5 \times 16$
Finally do the multiplication
$= 80$

Abstract

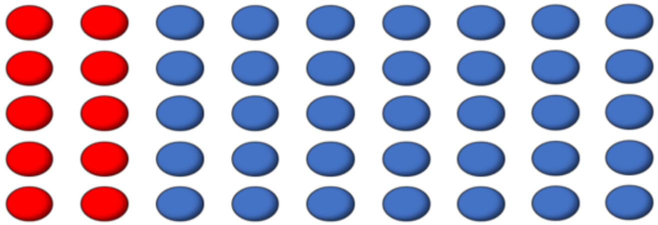
Work out $5 \times (6 - 2)^2$

We use the word BIDMAS where

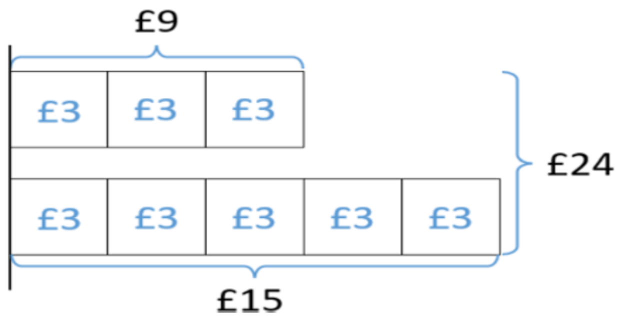
BIDMAS stands for **B**rackets, **I**ndices, **D**ivision, **M**ultiplication, **A**ddition, **S**ubtraction.

$5 \times (6 - 2)^2$
Do the bracket first
$= 5 \times 4^2$
Do the index number next
$= 5 \times 16$
Finally do the multiplication
$= 80$

Simplifying a ratio

Example Simplify the ratio 10:35	
Concrete/Pictorial	**Abstract**
 Represent the ratio 10:35 with the 10 red balls and 35 blue balls above. We find the biggest number that divides exactly into both 10 and 35 which is 5. Therefore, we arrange both the red balls and blue balls into 5 rows. We can see that each row has 2 red balls and 7 blue balls. In other words, if you have 10 red balls and 35 blue balls that means for every 2 red balls you will have 7 blue balls. Therefore, 10:35 can be simplified to 2:7.	**Simplify the ratio 10:35** We start by finding the biggest number that divides exactly into both 10 and 35 (which is called the highest common factor). That number is 5. 10 ÷ 5 = 2 35 ÷ 5 = 7 So 10:35 simplifies to 2:7.

Sharing a quantity in a ratio

Example Share £24 into the ratio 3:5	
Concrete/Pictorial	**Abstract**
 Represent this question using bar models. We start by drawing 3 boxes for the first share and 5 boxes for the second share as can be seen above. This gives us 8 boxes altogether. To work out what each box is equal to we need to do £24 ÷ 8 = £3. Therefore, the first share is 3 x £3 = £9 Therefore, the second share is 5 x £3 = £15. Therefore the answer is £9:£15.	**Share £24 into the ratio 3:5** The first share is 3 parts of the ratio and the second share is 5 parts of the ratio. We start by adding 3 parts and 5 parts which gives us 8 parts in total To work out what each part is equal to we need to do £24 ÷ 8 = £3. Therefore, the first share is 3 x £3 = £9 Therefore, the second share is 5 x £3 = £15. Therefore the answer is £9:£15.