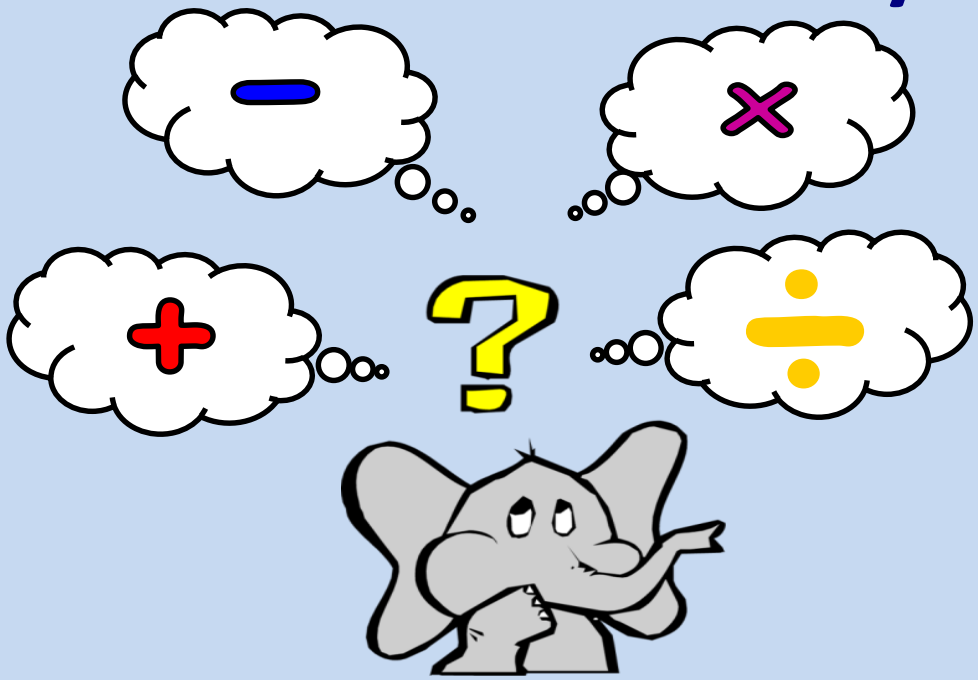
The Marist Catholic Primary School

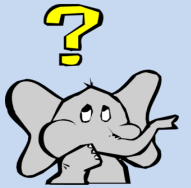


Progression in Calculation

Welcome

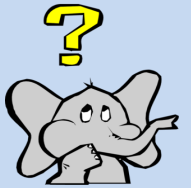
- Have a go at some Year 6 Arithmetic questions!

The Aims Of The Evening



- Share with you the ways in which calculations (the four rules of addition, subtraction, multiplication and division) are taught at the Marist
- Share with you the expectations in Maths at Year 6
- Give you some tips on how to support your child in their learning of Maths

By The End Of Key Stage 2



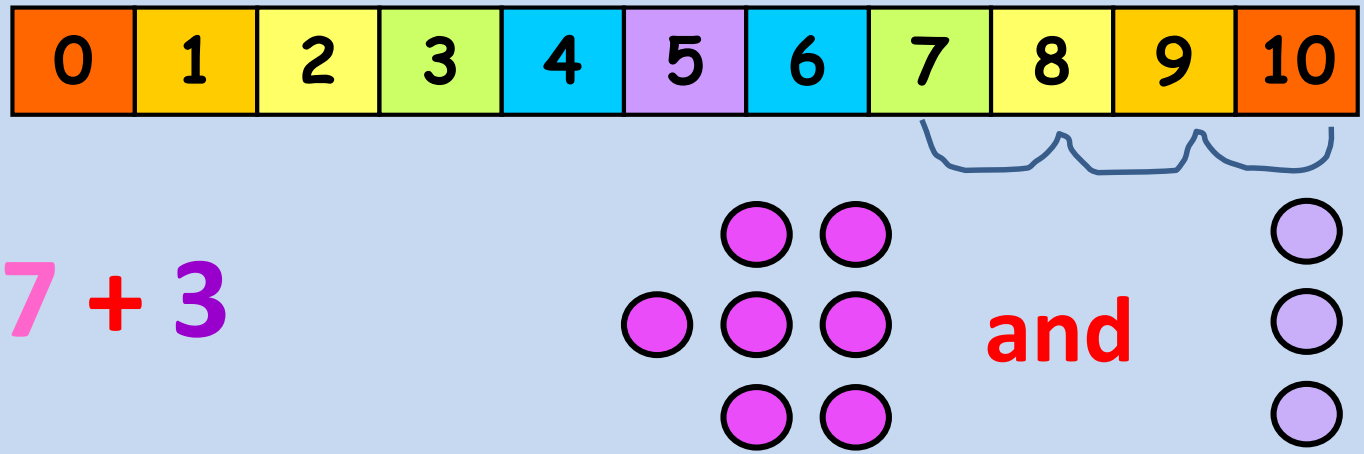
- **What is the problem about** – which operations (+, -, x or ÷) will I need?
- **Can I do this in my head?**
- **Can I do it in my head but with the help of some drawings or jottings?**
- **Do I *need* to use a written method?**
- And then, having completed the calculation…
- **Is my answer a reasonable or sensible one?**

Progression in Addition

Number Names and ordering

One of the first things we do is teach the children the names of the numbers and their order. This means that the children can begin to count objects and to see the relationship between how many and an actual number.

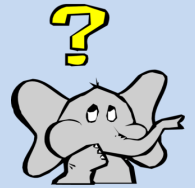
Some number relationships will be taught such as the “number bonds to 10”. This is important for the children to understand the effect of adding a 3 to a 7 or a 1 to a 9 and so on.



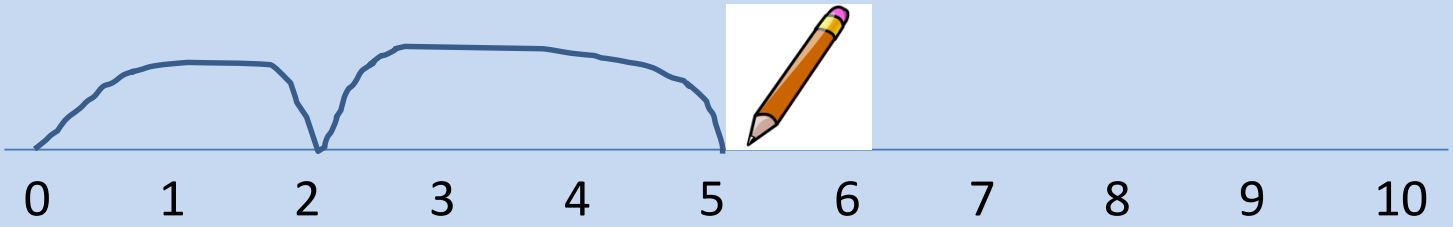
Number lines and other graphic methods

The next step is to use numbers of objects to add
For example, *if I eat 3 sweets and then 2 more, how many have I eaten?*

The children can use actual groups of objects to work out the answer once their understanding of the number names and order is secure.
The children may then start independently to draw pictures or make a tally to help them with the addition.

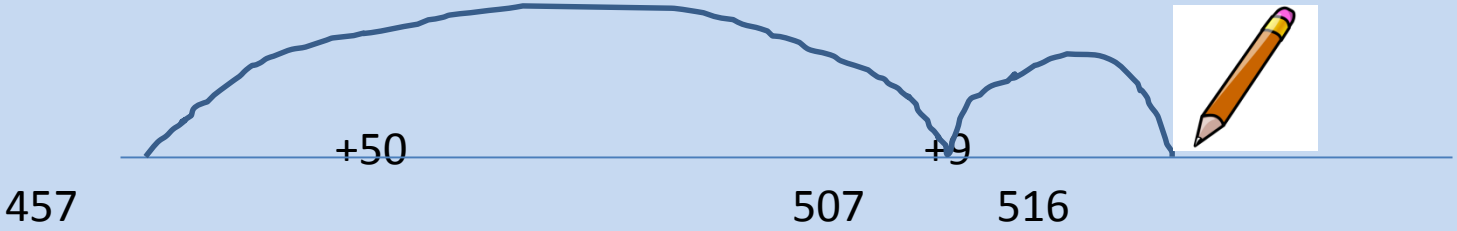


This progresses to the use of a number line:

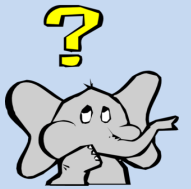


From here the children can continue to add by counting on. So, if I eat 3 more sweets, how many will I have eaten in total?

Please note that the use of the number line continues right through the school – it is not an infants' tool! An "empty number line"can be used for more complicated calculations such as 457 + 59, provided that the child has a good understanding of number and can "partition" ie see 59 as 50 + 9



Partitioning and recombining



As the calculations get more complicated and the use of mental maths on its own or number lines become less efficient, so the children progress to more formal written methods.

These rely on an understanding of place value and the ability to partition ie knowing that the digit 4 in 46 actually has a value of 40 or 4 tens etc, meaning that 46 is made up of 40 + 6

A calculation can then be completed as follows:

My sunflower is 47cm tall. It grows another 39cm. How tall is it now?

Tens		Units	
40	+	6	
30	+	9	
70	+	15	= 85

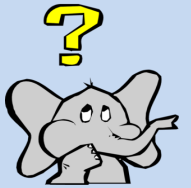
Expanded written method with exchanging

There is then a natural progression to start to talk about "exchange" where, for example, 10 units are exchanged as 1 ten and shown in the tens column:

There are 467 girls and 529 boys in the secondary school. How many children all together?

Hundreds	Tens	Units	
400	+ 60	+ 7	
500	+ 20	+ 9	
900	+ 90	+ 6	= 996
	10		

Compact written methods



Once children are confident with the expanded written method, then they are ready for the more traditional compact method of addition: there is nothing to be gained – except confusion – by teaching this method until children have a real and secure understanding of place value and of the concept of exchange. This is generally in upper Key Stage 2.

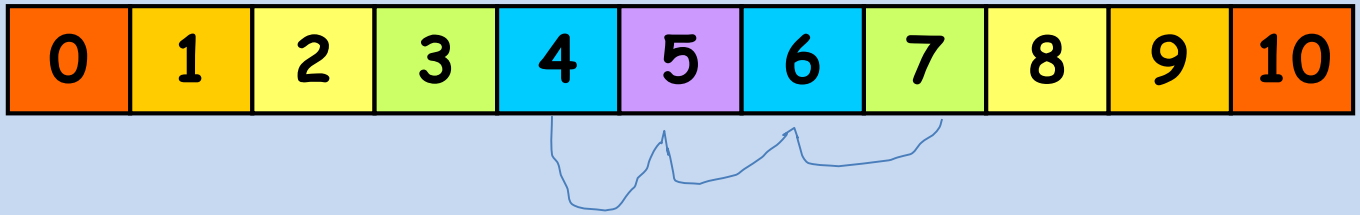
6,874 Woking supporters were at the Final and 3,837 Luton fans. How many fans were there in total?

$$\begin{array}{r} 6\ 8\ 7\ 4 + \\ 3\ 8\ 3\ 7 \\ \hline 1\ 0\ 7\ 1\ 1 \\ \hline 1\ \ 1\ \ 1\ \ 1 \end{array}$$

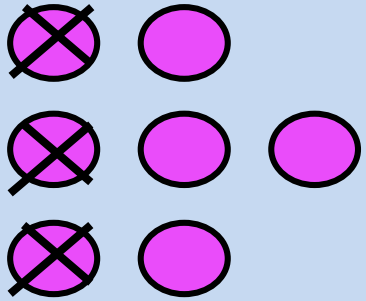
Progression in Subtraction

Number Bonds

Again, simple subtraction can follow an understanding of basic number bonds to 10. If I know 3 + 7 is 10, the next step of understanding is that if I take 3 away from 10, I will be left with 7.



7 - 3

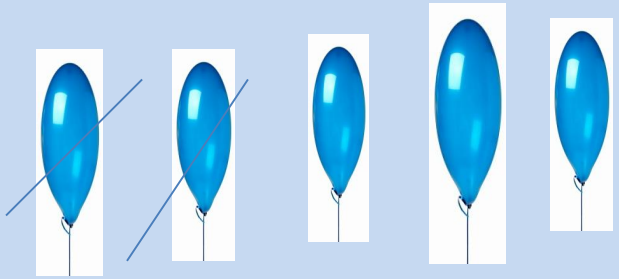


Practical and Graphic Methods

Children will start by using objects as soon as they can reliably count and identify the order of number. For example,

I have 5 balloons but 2 burst. How many have I got left

5 take away 2… there are 3 left



Working independently the children will then start to show the calculation by drawing or using dots or a tally – it shows that they can visualise the calculation: the first step to a mental calculation.

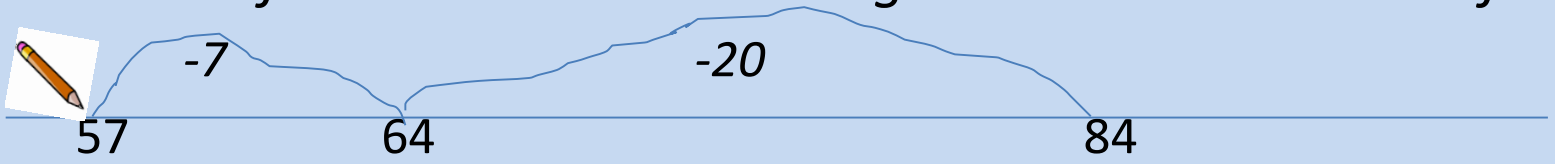
This will then progress to the use of the number line.

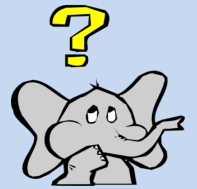
Counting back and counting on

As with addition, once the children are confident with place value and partitioning, they can then start to use the empty number line efficiently

Counting back:

I cut 27cm from a ribbon measuring 84cm. How much is left?



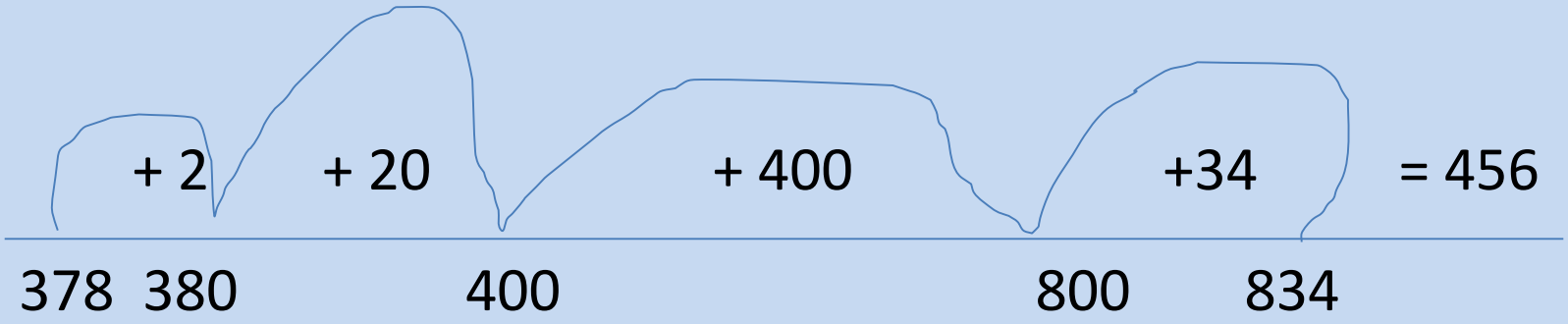


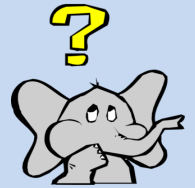
Counting on:

Sometimes it is easier to count on from the smaller number to the larger number to find the difference between them.

The library lends 378 of its 834 books. How many are left on the shelves?

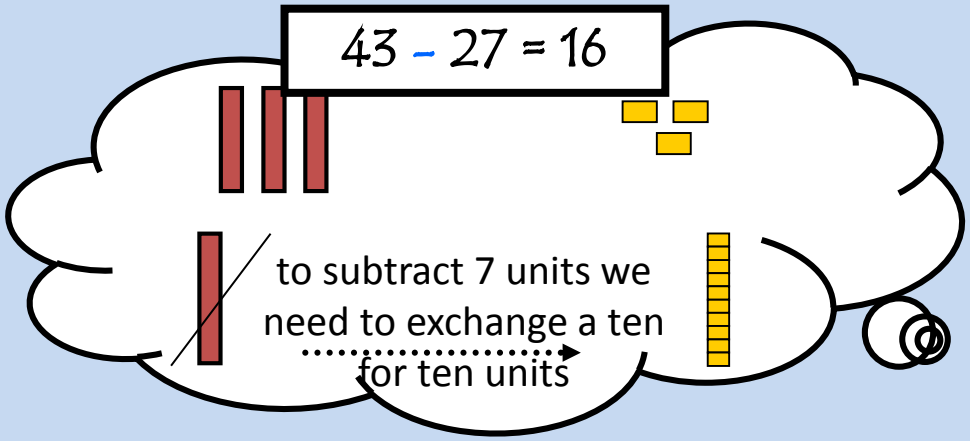
The calculation is 834 – 378 or finding the difference between 378 and 834…





The first written method introduced is an expanded one to help the children understand what is happening. It is at this stage that the children need to start exchanging tens for ten units or hundreds for 10 tens. Traditionally we have may said “borrowed” but this gives a false impression that we will give it back! Today we use the term “exchange”.

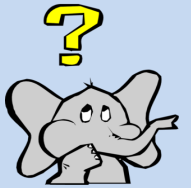
There are 43 children in the hall and 27 leave. How many children are still in the hall?



30 ~~40~~ 10+ 3

\- 20 7

10 and 6 = 16



Here is another example where a 10 is exchanged from the tens column to the units AND a 100 is exchanged from the hundreds column to the tens.

There are 754 ants in the ant hill but 286 leave to collect food. How many ants are left in the ant hill?

Hundreds		Tens		Units	
600 ~~700~~		100 + 40 ~~50~~		10 + 4	
- 200		80		6	
400	**and**	60	**and**	8	= 468

Compact written methods with exchanging

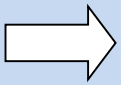
Once children are confident with what they are doing, then it is possible to compact the method to the more traditional written method with which parents may be more familiar. Again, without an understanding of why they are doing this, the method can be very confusing indeed!

There are 643 children in the hall and 287 leave. How many children are still in the hall?

500 600 100 + 30 40 10+ 3

\- 200 80 7

300 and 50 and 6 = 356

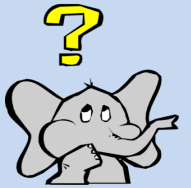


5 6 13 4 1 3

\- 2 8 7

3 5 6

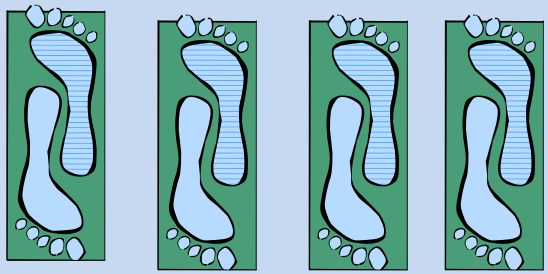
Progression in Multiplication



Repeated addition with graphic methods

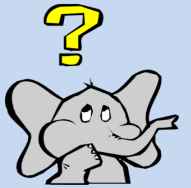
Children are introduced to multiplication first as repeated addition. As in every case this will start with the use of physical objects and then move to pictures and other graphic methods. For example:

Each child has two feet. How many feet do four children have?



2 + 2 + 2 + 2 = 8

Arrays and Number Lines



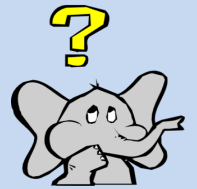
An array is a way of showing data in a regular rectangular form of columns and rows so, for example it can help with 3 x 4:

●●●
●●●
●●●
●●●

or

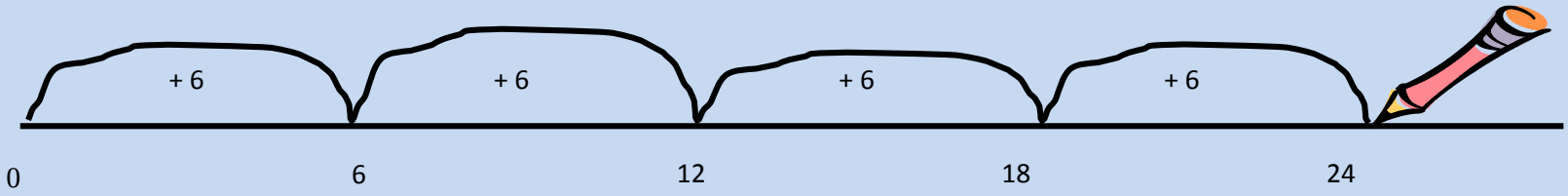
●●●●
●●●●
●●●●

This also helps children to understand that 3 x 4 is the same as 4 x 3.



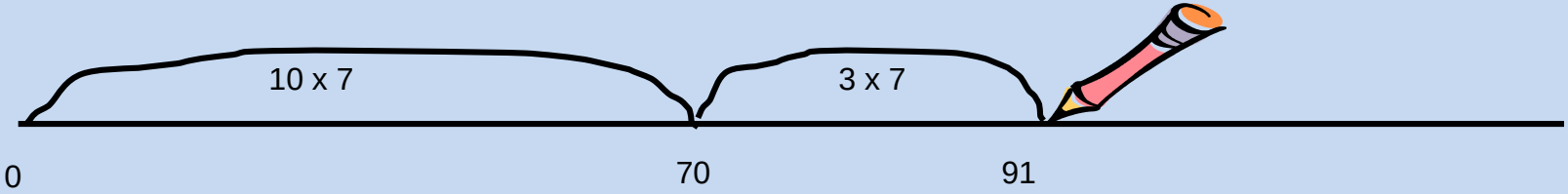
The use of the number line is for repeated addition:

There are 4 cats. Each cat has 6 kittens. How many cats are there altogether?

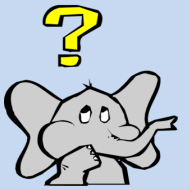


This can be developed for larger numbers by using known facts:

There are 13 biscuits in a packet. How many biscuits in 7 packets?



Grid method with partitioning



The more advanced use of the number line leads naturally to the grid method – the first written method we teach for multiplication. This is dependent on a secure understanding of place value and partitioning.

x	10	3
4	40 +	12

= 52

A block is 193cm high. How high would 6 blocks be if they were placed on top of each other?

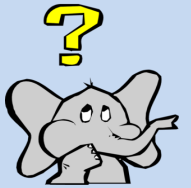
x	100	90	3
6	600 +	540 +	18

= 1158

This method can be used for numbers of any size provided the child is confident in partitioning:
Eg 34 x 27

x	30	4	
20	600 +	80	680
7	210 +	28	238 +
so	34 x 27 =		918

Expanded written method



This method takes the grid method and starts to put it in to a vertical structure as an introduction to the conventional compact method. Again, it depends on a secure understanding of place value and partitioning:

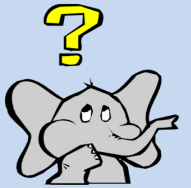
A block is 193cm high. How high would 6 blocks be if they were placed on top of each other?

193 x 6

	9 3	
X	6	
	1 8	(3 x 6)
5	4 0	(90 x 6)
6	0 0	(100 x 6)
1 1	5 8	

1

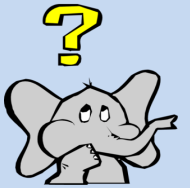
Compact Written Method



The expanded method is eventually reduced to the compact method for short multiplication (a number x by a single digit). The recording is reduced with the carry digits recorded below the line.

```
  1  9  3
  X     6
-----------
  1  1  5  8
-----------
  1  5  1
```

Long Multiplication



The final step is the introduction of long multiplication (a number multiplied by more than 1 digit).

Children can use the grid method, the expanded method or the compact method.

However, it is essential that children understand place value before tackling the compact method of long multiplication as they have to understand the need to place a 0 in the units column when multiplying by tens in order to "hold the place", to be a placeholder…

There are 52 weeks in a year. How many weeks in 27 years? 52 x 27

There are 52 weeks in a year. How many weeks in 27 years?

x	50	2	
20	1000+	40	1040
7	350 +	14	364 +
so	52 x 27 =		1404

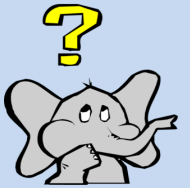
```
   5  2
  X2  7
     1  4      (7 x 2)
  3  5  0      (7 x 50)
     4  0      (20 x 2)
1  0  0  0      (20 x 50)
1  4  0  4
   1
```

```
      5  2
     X2  7
     3  6  4      (52 x 7)
+ 1  0  4  0      (52 x 20)
  1  4  0  4
     1
```

Progression in Division

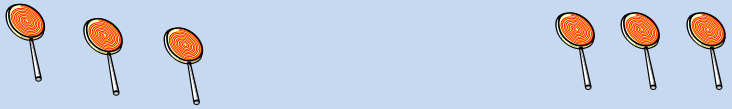
Division is seen as the hardest operation – but it shouldn't be! It is the inverse (opposite) to multiplication. A good grasp of times tables, understanding not just reciting, will really help!

Sharing and grouping



Children start by sharing and grouping.
Again, practical objects and then images are the way in.

For example, *There are 6 lollies to be shared between 2 children, How many lollies will each child get?*
Sharing: one for you, one for me…until all are gone

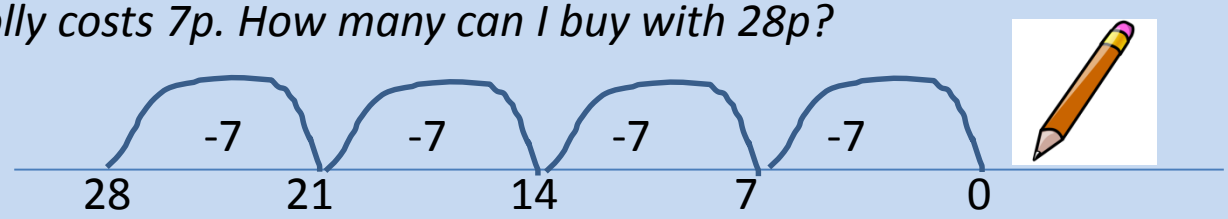


Or There are 6 lollies. How many children can have 2 each?
Grouping: in two's

Repeated Subtraction and Number Lines

Number lines can be used for repeated subtraction:

A lolly costs 7p. How many can I buy with 28p?

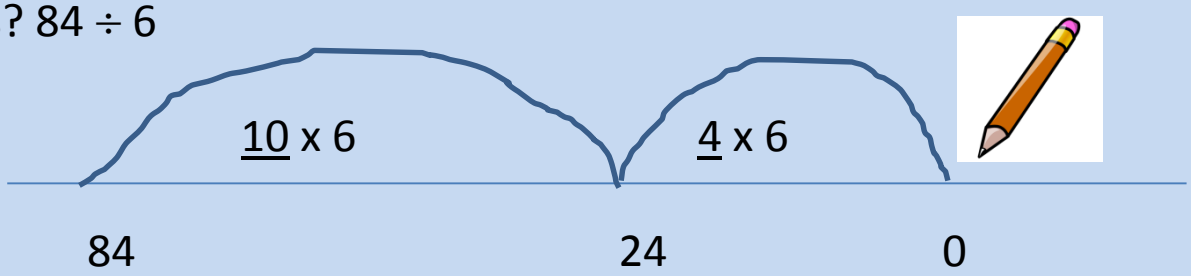


4 jumps of 7, so 28 ÷ 7 = 4

This can also work where there are remainders.

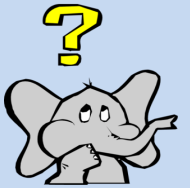
This can be further developed by using larger "chunks" of the divisor, for example:

I need 6 pins to put up a picture. How many pictures can I put up with 84 pins? 84 ÷ 6



So 84 ÷ 6 = 14

Repeated Subtraction and 'Chunking'



Chunking is simply repeated subtraction of "chunks" of the divisor. However, children need to understand that chunking is inefficient if too many subtractions have to be carried out. The chunks need to be sensible amounts eg a multiple of 10…

I have 200 chairs to arrange in to rows of 6. How many rows will I have?

Chunking

6) 200

200
-6
194
-6
188
-6
continuing
-6
2
33 r 2

6) 200

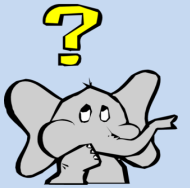
200
-60 (10 x 6)
140
-60 (10 x 6)
80
-60 (10 x 6)
20
-18 (3 x6)
2
33 r 2

6) 200

200
-180 (30 x 6)
20
- 18 (3 x 6)
2
33 r 2

The more confident the understanding, the larger the 'chunks' and the more efficient the method.

Short Division

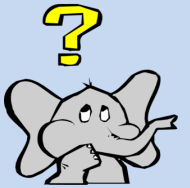


Short division uses the ‘bus shelter’ method.

e.g. *I have 200 chairs to arrange in to rows of 8. How many rows will I have?*

$$\begin{array}{r} 3\ \ 3 \quad \text{r } 2 \\ \hline 6\overline{)\,2\ {}^{2}0\ {}^{2}0} \end{array}$$

Long Division



The final step is to tackle long division.

This is where you divide by more than 1 digit.

For UKS2 children this usually means dividing by a 2 digit number.

Again, depending on their understanding, children can use chunking or the compact method.

Long Division

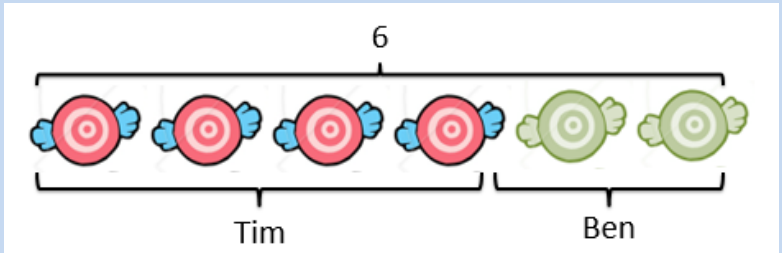

```
   23 r 8
24) 560
   -240   (10 x 24)
    320
   -240   (10 x 24)
     80
   -  72  (3 x 24)
      8
```

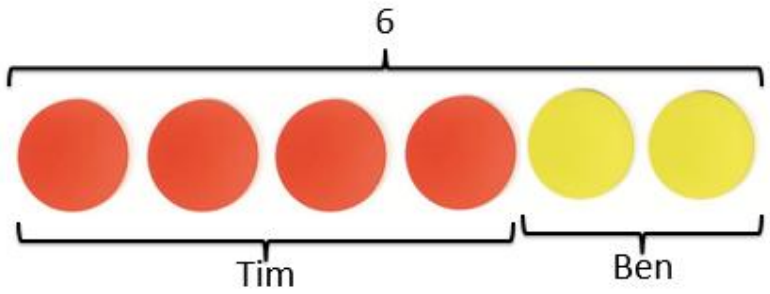
```
   23 r 8
24) 560
   -480
     80
   -  72
      8
```

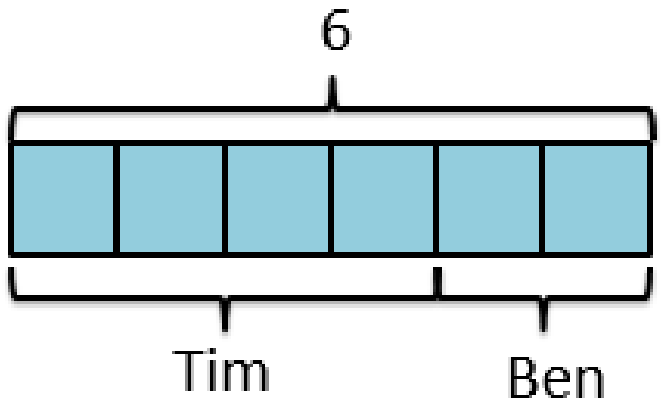
It is important that children always try to estimate first to check that their answer makes sense.

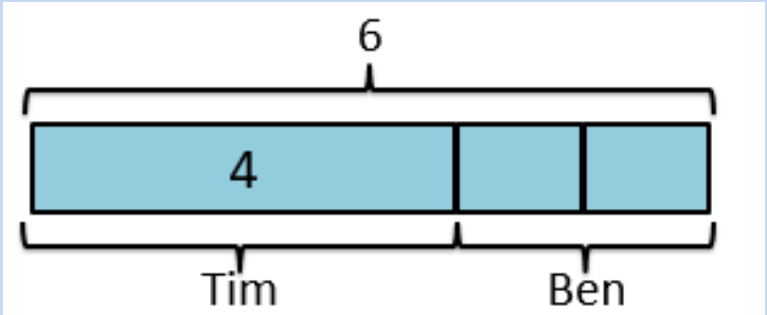
Bar Model

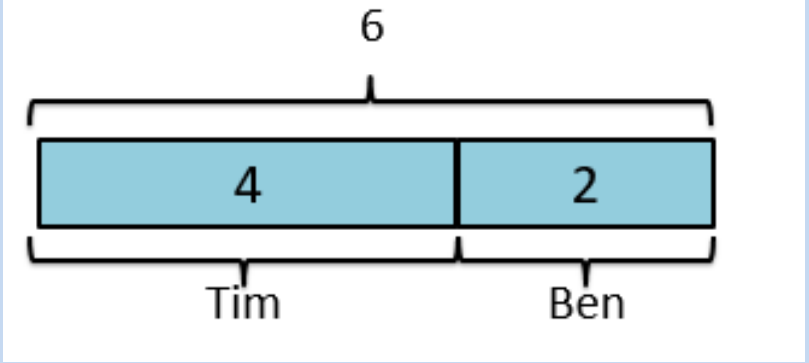
Small steps











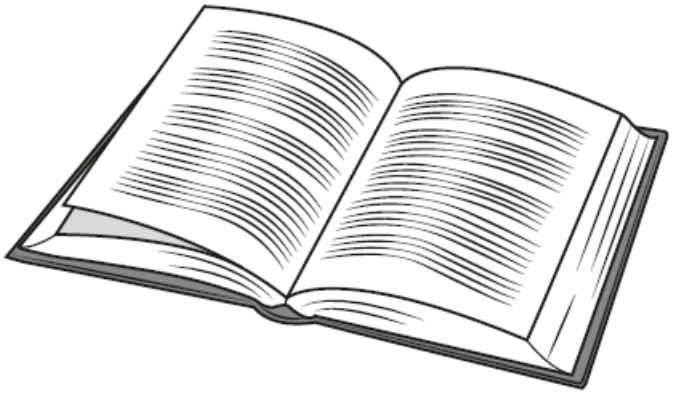
4 + 2 = 6

KS2 barmodelling

$\frac{3}{5}$ of 20 = ?

Have a go..

On Saturday Lara read $\frac{2}{5}$ of her book.



On Sunday she read the **other** 90 pages to finish the book.

How many pages are there in Lara's book?

How to support your children at home

- TTRockstars – (*soundcheck mimics year 4 timestable test)*
- Times tables
- Mymaths
- Money and time
- Measurement
- Look at the calculation policy on the school website.

Survey