

Calculations Policy for Parents

If you were brought up on pages of 'hard sums' you may think mathematics is difficult and boring. Worse than that you may think you're not very good at it! That's a real shame because it is a fun subject and for most people, if they are taught to understand numbers, they should find them reasonably easy to grasp and use.

If what you remember as mathematics is pages of calculations you may sometimes feel confused when your child's maths book contains writing, pictures, diagrams, jottings or blank number lines and not many 'formal calculations'. Certainly younger children, up to at least year 3, will record calculations in a variety of ways that do not necessarily look like the kind of 'sums' you remember. This is because written calculations are not the ultimate aim: the aim is for children to do calculations in their heads and, if the numbers are too large, to use a way of writing them down that helps their thinking. This will, in years 4, 5 and 6, include some vertical written methods you will recognise.

As children develop their knowledge and understanding through years 3,4,5 and 6 teachers will be asking them to look at any calculation and ask "Can I do this in my head?" Sometimes this will need to be supported by a drawing, diagram or numerical jotting (notes). If they can't do it largely in their heads they should be looking for the most suitable written method or, during years 5 and 6, using a calculator for more complex calculations.

Here we try, as simply as possible, to help you to help your children. We take you through the ideas relating to children's number development from the earliest counting and mental skills to their recording of calculations to support thinking. If you've never felt very confident with numbers and calculations this might also help you! Read on and see.



Looking at addition and subtraction

When children are in years 1 and 2 (or less able children in higher year groups) they are **not** expected to do vertical calculations like

$$\begin{array}{r} 6 \\ +4 \\ \hline 10 \end{array}$$

but that doesn't mean they won't learn that $6+4=10$. They will be doing a daily mixture of practical, mental and oral work including lots of counting, talking about numbers and using numbers in real life activities. They will begin to record what they've done with pictures and numbers. These recordings will help them to understand what is happening and to show how they've worked something out. Here are two examples of early recording.

Jane had 3 bears. She was given 2 more. How many does she have now?

There were 8 balloons. Two popped. How many are left?

This next example shows how different children have worked out and recorded the answer to the same problem about the children in the class.

There are 20 children in our class. Three are away today. How many are here?

2 away would be 18
so 3 away must be 17.

20 - 3 = 17

These diagrams and jottings help the children to see what is happening to the numbers and to use some facts they already know to help them work out others.

In years 3 and 4 children will carry on using horizontal recording of addition and subtraction to support their mental calculations. The example below shows a common way of adding 76 and 93. It first splits (we refer to this as partitioning) the numbers into tens and ones (units) then adds the tens followed by the ones to give 169.

In a school there are 76 boys and 93 girls. How many children are there altogether?

$$\begin{aligned} 93 + 76 &= 90 + 70 + 3 + 6 \\ &= 90 + 70 + 9 \\ &= 160 + 9 \\ &= 169 \end{aligned}$$

The following example demonstrates how children might use facts that they already know, or things they can work out easily, to calculate.

There are 76 boys and 93 girls in the school. Find how many more girls there are than boys?
One strategy might be recorded as:

$$93 - 76$$

$$93 - 73 = 20$$

So $93 - 76 = 17$

Children will also continue to use drawings, diagrams and blank number lines to support their thinking, as below.

There are 13 boys and 8 girls in the room. How many altogether?

$13 + 8$

There are 34 children in the classroom. 27 go to the hall. How many are left?

$34 - 27$:

Towards the end of year 3 and into year 4 most children will be taught written methods, including vertical addition and subtraction, for those calculations that they can't do 'in their heads'. At this stage these will be 'expanded methods' which are ways of recording that make the process of adding or subtracting the different digits clear to children. These expanded methods build on the mental methods they have been learning and should help children to understand what is happening. Here is an example of adding using an expanded method.

The blue team's score of 287 points is increased by 145 points. What's the new score?

$$287 + 145 =$$

$$200 + 100 = 300$$

$$80 + 40 = 120$$

$$7 + 5 = 12$$

$$\underline{432}$$

Shown next is the same question set out in a different way but using the same ideas. It includes an explanation of what might be said to describe the adding.

The blue team's score of 287 points is increased by 145 points. What is the new score?

$$\begin{array}{r}
 287 \\
 + 145 \\
 \hline
 300 \\
 120 \\
 \hline
 12 \\
 \hline
 432
 \end{array}$$

Explanation.....

The language used is very important to help children understand the size of numbers being added (e.g. is it seven or seventy or seven hundred)

two hundred plus one hundred equals three hundred

eighty plus forty equals one hundred and twenty

seven plus five equals twelve

finally three hundred plus one hundred and twenty plus twelve equals four hundred and thirty two

An expanded method for subtraction is shown below.

The blue team scored 287 points and the red team scored 145 points. By how many points did the blue team win?

$$\begin{array}{r}
 287 \\
 -145 \\
 \hline
 5 \\
 50 \\
 \hline
 87 \\
 \hline
 142
 \end{array}$$

up to 150

up to 200

up to 287

Explanation...

Children are finding the difference between the two numbers by counting up from the smaller to the larger

from one hundred and forty five to 150 is five

from one hundred and fifty to 200 is fifty

from two hundred to 287 is eighty seven

finally, five plus fifty plus eighty seven is one hundred and forty two

These methods mean that children may have to write a little more at this stage but, because it helps and supports their understanding, it enables them to become much more confident and quicker in the long run.

Once children really understand what they are doing they can be quickly taught how an 'expanded method' can be 'squashed' into the 'compact' method that you may recognise.

Try to decide how you would do the following calculations. Would you do them in your head, write them down or use a calculator? The notes may change your mind but don't read them until you've had a go at the calculation.

| | | | | |
|--|---|---|--|---|
| 45+99 | 3006-2999 | 2.3 + 6.99 | 4532-3768 | The sum of all the numbers from 1 to 10 |
| This is easy to do if you think of 99 being one less than 100. So add 100 to make 145 and then take away 1 to give 144 | These numbers are very close on the number line. We need 1 to get from 2999 to 3000 and 6 more to get to 3006 so the difference is 7. So much easier than doing a vertical sum! | This addition involving decimals may look hard but it's easier if you think of it as money. £2.30 add £6.99. So add £7 to get £9.30 and take away 1p to get £9.29 Easy! | This, for most people, needs a pencil and paper or calculator if speed is important. | This is easy if you think of pairs of numbers making 10 1 + 9 = 10 2 + 8 = 10 3 + 7 = 10 4 + 6 = 10 Finally 5 + 10 = 15 giving a total of 55 |

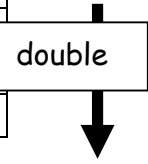
It is important that calculations are presented in problems or horizontally, as above, to encourage children to think about the numbers as a whole, what they mean, what a sensible answer might be and the best method of working them out. It's all about giving children confidence with and control over numbers.

Looking at multiplication and division

Did anyone ever tell you that you only needed to learn about half of the multiplication tables in order to know them all? If they didn't it was a bit mean because if you know $3 \times 4 = 12$ you also know $4 \times 3 = 12$, so why learn it twice?

Did anyone ever say that once you knew the 2 times table, which is only double the 1 times, then the 4 times was easy because you just double the 2 times? Then you can double the 4 times to get the 8 times. The 3 times doubles to the 6 times and 12 times, the ten times can be halved to give 5 times and so on. This uses the knowledge children are developing through addition and subtraction and makes important connections for them. This chart shows how this works for the 2x, 4x and 8x tables.

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------|---|----|----|----|----|----|----|----|----|----|
| 2times | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| 4times | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 |
| 8times | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 |



It's also possible that you weren't told that you knew your division tables. If you were shown that division was the opposite of multiplication you will understand that knowing $3 \times 4 = 12$ or $4 \times 3 = 12$ also means you know $12 \div 4 = 3$ and $12 \div 3 = 4$. So knowing one number fact, like $3 \times 4 = 12$, immediately means we know at least four.

But did you also realise that knowing any one of these facts helps you to know a lot more than four without actually learning them? Read on.

The early work children do will introduce them to the ideas of multiplication and division. They will be counting in different patterns, helped to see how multiplication is repeated addition and division is repeated subtraction, shown how division is the opposite of multiplication and taught to understand place value (that in 234 the 2 is 200, the 3 is 30 and the 4 is 4 ones (units)). This knowledge and understanding, with much of the work being done in their heads, opens up a whole world of facts for them and they don't all have to be memorised. That can make dealing with numbers feel a lot easier.

The following chart shows something of what this means.

If you know $4 \times 5 = 20$ what else do you know?

$$5 \times 4 = 20$$

$$20 \div 4 = 5$$

$$20 \div 5 = 4$$

$$4 + 4 + 4 + 4 = 20$$

$$5 + 5 + 5 + 5 = 20$$

and using knowledge of place value

$$5 \times 40 = 200$$

$$4 \times 50 = 200$$

$$200 \div 50 = 4$$

$$200 \div 40 = 5$$

$$40 \times 50 = 2000 \text{ and so on}$$

combined with knowing the multiples of ten, which are easy, we can work out that

$$5 \times 44 = 220 \quad (5 \times 40 = 200 \text{ and } 5 \times 4 = 20 \dots 200 + 20 = 220)$$

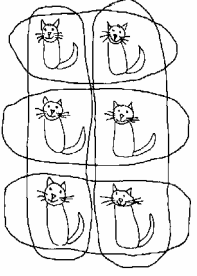
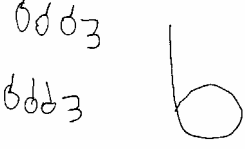
therefore

$$220 \div 5 = 44$$

and so it goes on. Try it for yourself..in your head!

The ability to do what you've just seen, developed gradually through years 1,2,3 & 4 helps children in years 4,5 & 6 to move on with confidence to multiplication and division of bigger numbers including those involving decimals and as with addition and subtraction, the questions will usually be presented to children as word problems or, horizontally, as calculations. The children should then be encouraged to work them out mentally if they can (supported by drawings, diagrams, number jottings if necessary) or, if they can't, to use the most suitable written method they know.

In years 1 & 2 (or less able children in higher year groups) the children will be recording to demonstrate how they have done something and to show that they've understood what is happening, as below.

| | |
|--|---|
|  |  |
| $2 \times 3 \text{ cats} = 6 \text{ cats}$ $3 \times 2 \text{ cats} = 6 \text{ cats}$ | $2 \text{ lots of } 3 \text{ apples makes } 6 \text{ apples.}$ |

In years 3 & 4 the children will begin to use expanded methods to help them deal with calculations that they can't do in their heads. At this stage it will mostly involve multiplying and dividing 2 digit numbers by a single digit (72×6 or $85 \div 4$). When dividing they will learn about and use remainders. The use of jottings to support children's calculations is encouraged.

In this example, the 47 has been split (partitioned) into 40 and 7 before the calculation is carried out. This makes it simpler to calculate each part mentally.

$$47 \times 8 =$$

$$(40 \times 8) + (7 \times 8) =$$

$$320 + 56 = 376$$

A popular expanded method for multiplying is often called the grid method. It uses the mental skills and the knowledge children have been learning and will help most children to move, with understanding, to the 'compact' method you may know.

This chart shows 'the grid method'. You can see, as with addition and subtraction expanded methods, it uses knowledge of number facts and the idea of splitting a number into its parts (place value) to help understanding of the process.

How many sweets do I need for 24 party bags if each is to have 16 sweets?

| | | |
|----|-----|----|
| x | 20 | 4 |
| 10 | 200 | 40 |
| 6 | 120 | 24 |

Total:
 $200 + 120 +$
 $40 + 24 = 384$

You will see the 24 and 16 have been split and then each part of the grid has been completed by calculating mentally and the four numbers added to give the final total. Many children will eventually develop the ability to do this kind of calculation totally in their heads.

The expanded method for division is often called 'chunking' and really just involves taking away chunks of the same size until you run out. It uses the fact that division is repeated subtraction of the same size group. So $20 \div 4 = 5$ involves subtracting 4s from 20 until it's been used up. You can do this 5 times. Here is a more difficult example showing how larger chunks are taken away to speed up the process. Again this method uses and builds on the ideas explained earlier.

72 pears are sold in packets of 6. How many packets will that make?

| |
|--|
| 72 (pears) |
| - 60 (this is 10 lots of 6) |
| 12 (left over) |
| - 12 (this is 2 lots of 6) |
| 0 (left over) |
| So 10+2 lots of 6 or 12 packets can be made. |

As they move into years 5 & 6 children will still be encouraged to choose the most suitable method of calculation, mentally if possible. Where this is not possible they will be using expanded or compact methods and a calculator for more complex and involved work.

Most children will be expected to multiply 3 digits x 1 digit and 3 digits x 2 digits using a written method. Here are some examples.

How many hours are there in the year 2001?

This means we have to do 365×24 ...a calculation you may find quite hard. Here it is expanded and using lots of mental skills...but none of them difficult.

| | | | | |
|----|------|------|-----|--------|
| x | 300 | 60 | 5 | |
| 20 | 6000 | 1200 | 100 | = 7300 |
| 4 | 1200 | 240 | 20 | = 1460 |

So $20 \times 365 = 7300$
 $4 \times 365 = 1460$
giving a total of 8760 hours with no difficult calculation to do.

More complex division will involve dividing 3 digit numbers by a 1 digit number and 3 digit numbers by a 2 digit number. With division, as with all calculation, it's important to think about what the actual problem is asking when you come to give an answer. This is shown up in the second example of expanded division or chunking involving buses for a school trip.

458 stickers are shared between 3 children. How many does each get?

| | |
|---------|----------------------|
| 4 5 8 | |
| - 3 0 0 | that's 100 x3 |
| 1 5 8 | left |
| - 1 5 0 | that's 50 x3 |
| 8 | left |
| - 6 | that's 2 x3 |
| 2 | left over |

So each gets **100+50+2** or 152 stickers with 2 left over.

$$458 \div 3 = 152 \text{ remainder } 2$$

432 children and adults are going on a school trip. If each bus takes 30 people how many are needed?

| | | |
|---------|----------------------|--------------------|
| 4 3 2 | people going | |
| - 3 0 0 | that's 10 x30 | or 10 buses |
| 1 3 2 | left | |
| - 1 2 0 | that's 4 x30 | or 4 buses |
| 1 2 | left | 1 bus |

So we see that the calculation would result in

$$432 \div 30 = 14 \text{ remainder } 12$$

This is not a good answer for this question because the 12 people left over would need another bus or they couldn't go!

So we see that 15 buses are needed...or some cars.

When the children really understand these expanded methods they can be shown how they are developed into a compact method. Remember though that the expanded methods are perfectly good ways of working out an answer if the children feel more comfortable and therefore find it easier. They give the same answer and it can often be quicker if they are confident about what they are doing.

Hopefully reading this has made you feel a little more confident and comfortable with numbers and calculations yourself, if you weren't already, and therefore better able to help your child. Remember if you have any concerns or questions it's always better to talk to your child's teacher rather than pulling the children in different directions or worrying about what's going on. Children (and adults) need to feel confident with numbers and to enjoy playing with them and using them, that's really what it's all about. It then means using them for everyday purposes becomes straightforward rather than a threat.

Finally, have a go at these using expanded methods. Trying things out helps understanding and the answers are at the bottom of the box for you so you'll know if you are correct. One of them at least could be done completely in your head...maybe! Remember we want children to decide on the best method, mentally if possible, or the most suitable, manageable written method if not.

| | | | | |
|-------------|------------------|--------------------|---------|-------------|
| calculation | a) 27×7 | b) 238×45 | | |
| working | | | | |
| calculation | c) $176 \div 6$ | d) $346 \div 16$ | | |
| working | | | | |
| answers | a)189 | c)29 rem 2 | b)10710 | d)21 rem 10 |

Several images in this document are used with kind permission of the Qualifications and Curriculum Authority.