Calculation policy – Pear Tree School

This policy outlines what we do at Pear Tree School to teach calculation. We support children in order to broaden, deepen and apply their calculation knowledge. Maths is not about number but about life. It is about the world in which we live. It is about ideas. We need to make maths exciting and meaningful for the children we teach.

By teaching mathematics creatively through story, dance, drama, music and the outdoors we enable the children to become enthused and interested. This in turn has a positive impact on their mind-set and feelings towards maths.

For each year group, the teacher assesses that the children have understood each process and strategy before moving on to the next stage in their learning. We understand that children learn at different rates and that not all children will be using the same strategy at the same time.

We encourage children to use a range of vocabulary to support their understanding of the process used in calculating. In all the methods of calculation it is important to encourage the children to estimate their answers.

All the time we are also encouraging the use of mental calculation as being able to calculate mentally is an important part of mathematics. Since multiplication and division, addition and subtraction are **inverse operations** they should be taught alongside each other rather than as separate entities. It is important that children are taught to appreciate and make use of these mathematical relationships when developing and using mental calculation strategies.

As calculations become more complex written methods become more important. Recording in mathematics and in calculation in particular is an important tool both for furthering the understanding of ideas and for communicating those ideas to others. A useful written method is one that helps children carry out a calculation and can be understood by others.

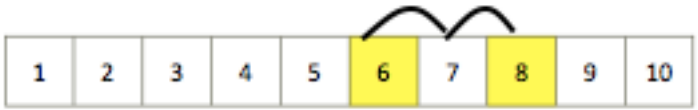
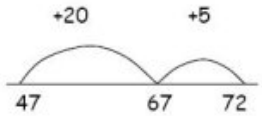
At each stage of their learning the children are encouraged to use manipulatives to help support their learning. Once the children become familiar with the different types of manipulatives in their classroom they will then start to take responsibility and choose the most appropriate one to help them with their calculation.

When using or applying calculation strategies children will be encouraged to consider what will be the most efficient and reliable way of doing the calculation:

Can I do this in my head?
Can I do this in my head using drawings or jottings?
Can I get something to support me with this calculation?
Do I need to use a written method?
Do I need a calculator?

Addition

Addition		
Stages of learning	**Examples of what it looks like**	**Vocabulary**
Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They should experience practical calculation opportunities using a wide variety of equipment, e.g. role play, counters, cubes etc. Children will begin to count in sets of objects.		add more groups how many

<table>
<tr><td>Children begin to combine sets of objects into one group and count practically.</td><td>Children may count an initial group then add more objects to that group.</td><td rowspan="2"></td></tr>
<tr><td>Children will use and draw pictures or symbols to begin solving and recording addition problems.</td><td>  </td></tr>
<tr><td>Children will begin to represent groups of objects with numbers to form basic number sentences.</td><td>5+3=8</td><td rowspan="2">total
how many
count on in
same as
equals
more
sum</td></tr>
<tr><td>Children will use a number track to visually support their adding on.</td><td>6+2=8
  </td></tr>
<tr><td>Children begin to cross the tens boundary and are beginning to set their calculations out in a more formal manner. They use number lines, hundred squares and other material to visually support their addition.</td><td>  </td><td rowspan="2">hundreds
tens
units
boundaries
partition
partitioning
near doubles
strategy
running total
mental calculations
place value</td></tr>
<tr><td>Children begin working with two digit numbers and to record mental methods using partitioning. It is vital that this stage the children should have a secure knowledge of place value.
Add the tens and then the ones to form</td><td>Record steps in addition using partitioning:

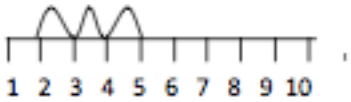
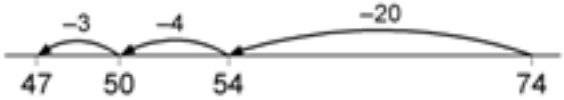
a) 47 + 76 = 123
47 + 70 = 117
117 + 6 = 123</td></tr>
</table>

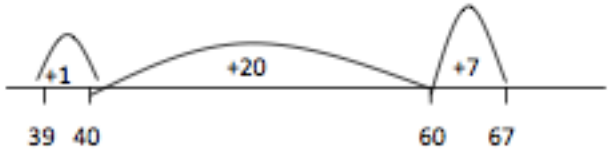
partial sums and then add these partial sums. Partitioning both numbers into tens and ones mirrors the column method where ones are placed under ones and tens under tens. This also links to mental methods. Partitioned numbers can then be written under one another. Partitioning is also a very useful strategy when beginning to add 3-digit numbers together.	b) 47 + 76 = 123 40 + 70 = 110 7 + 6 = 13 110 + 13 (10+3) = 123 47 = 40 + 7 +76 70 + 6 110 +13 = 123	
Children continue working with two digit numbers and set their work out using the expanded method in columns, making sure they line their relative place value columns up. They add the units first and then the tens. Their understanding of place value can help them to add the final section together mentally.	25 31 + 6 → *Children have added the units.* 50 → *Children have added the tens.* 56 → *Children have added the two parts together.*	

Number lines, hundred squares and other materials can still be used to visually support the child.		
Children continue this strategy. Moving on to bigger numbers such as, three digit plus 2 digit addition or with four digit numbers. Children may need to add with partitioning more than once to help them add the final number mentally more easily.	4301 +2973 4 70 1200 6000 7274	sum addition total altogether rounding partitioning decimals columns
As a final strategy, children are taught to condense their addition into a single step column method by carrying the digits which cross the tens boundary. This strategy will help them to add decimal numbers.	258 + 359 = 617 (1 1) 12.3 + 27.9 = 40.2 (1 1)	

Subtraction

Subtraction		
Stages of learning	**Examples of what it looks like**	**Vocabulary**
Children begin to practically remove objects from a group and use oral work to begin to understand the concept of subtraction.	Songs, stories and drama will be used for children to act out and represent the subtraction taking place.	take how many left less
Children will draw pictures or symbols and then cross them off to begin solving and recording subtraction problems.		
Children will begin to represent subtraction using basic number sentences but can still have the subject of objects.	5 - 2 = 3	difference take away subtract less than

Children begin to use vertical number lines to subtract. They will start at the highest number and count back. They will also use a vertical number line to find the difference. They will start at the lowest number and count up to the highest number to find the answer. They will be encouraged to do this mentally from 0-10 and then later from 0-20.	5 - 2 = 3  	
Children are beginning to subtract bigger numbers up to 100, recording their work on empty number lines. They will use the subtraction method of counting back from the biggest number. This requires children to subtract a single-digit number or a multiple of 10 from a two-digit number mentally. The method of recording links to counting back on the number line.	 	subtract inverse find the difference less than take-away partition partitioning strategy count on

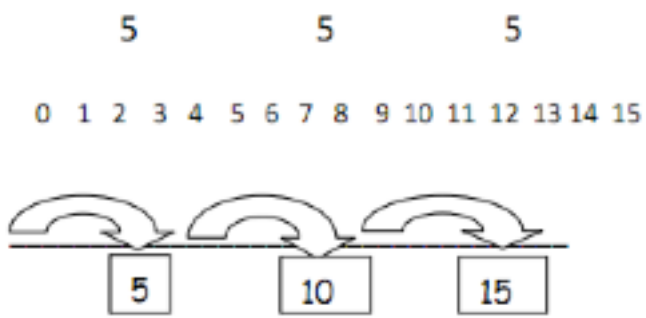
Complementary addition - they will also use a number line to find the difference/How many more? This can be referred to as the process as counting on. From the smallest number, they will jump to the next multiple of 10, then jump in multiples of 10, then add on the units. Children will add the jumps together to find their answer.	67—39 = 28 + 1 +20 +7  	
Along with using number lines children will use partitioning to subtract. It'll be recorded using partitioning to write equivalent calculations that can be carried out mentally. For 74 - 27 this involves partitioning the 27 into 20 and 7, and then subtracting from 74 the 20 and the 7 in turn.	Subtraction can be recorded using partitioning: 74 - 27 = 74 - 20 = 54 54 - 7 = 47	

Some children may need to partition the 74 into 70 + 4 or 60 + 14 to help them carry out the subtraction. Their understanding of place value can help them to add the final section together mentally. Partitioning can then become set out in a column formation to get the children ready for column subtraction – decomposition method.	Partitioned numbers are then written under one another: Example: 74 – 27 $\begin{array}{r} 70+4 \\ -\ 20+7 \\ \hline \end{array}$ $\begin{array}{r} {\scriptstyle 60}\ {\scriptstyle 14} \\ \cancel{70}+\cancel{4} \\ -\ 20+7 \\ \hline 40+7 \end{array}$ $\begin{array}{r} {\scriptstyle 6}\ {\scriptstyle 14} \\ \cancel{7}\ \cancel{4} \\ -\ 2\ 7 \\ \hline 4\ 7 \end{array}$ Example: 741 – 367 $\begin{array}{r} 700+40+1 \\ -\ 300+60+7 \\ \hline \end{array}$ $\begin{array}{r} {\scriptstyle 600}\ {\scriptstyle 130}\ {\scriptstyle 11} \\ \cancel{700}+\cancel{40}+\cancel{1} \\ -\ 300+60+7 \\ \hline 300+70+4 \end{array}$ $\begin{array}{r} {\scriptstyle 6}\ {\scriptstyle 13}\ {\scriptstyle 11} \\ \cancel{7}\ \cancel{4}\ \cancel{1} \\ -\ 3\ 6\ 7 \\ \hline 3\ 7\ 4 \end{array}$	

Children continue to develop their use of the number line for all subtraction work, including larger numbers and decimals. If they are ready to move on they begin to use the subtraction column method. Children should be confident in their ability to add when using this method. Finally, children are introduced to the decomposition method of column subtraction. For the subtraction 653 – 335, you cannot subtract 5 units from 3, therefore we exchange a ten from the 50 to add to the 3 units to make 13 units. Then the subtraction can continue as normal.	658 -351 307 6 4 5 13 -3 3 5 3 1 8	

Multiplication

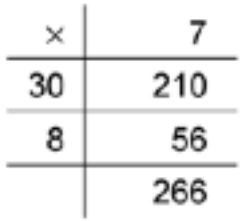
Multiplication		
Stages of learning	**Examples of what it looks like**	**Vocabulary**
Children will begin the process of multiplication by counting in groups or patterns in an informal or practical		sets of groups

manner.		
Children develop their concept of multiplication as grouping.	*e.g. three groups of two:* 	pattern groups addition lots of
Children will reinforce their concept of multiplication as repeated addition: 5 times 3 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3 They may use something like a number line to visually support their repeated addition.		repeated addition calculate inverse operation multiply
Children will begin to use arrays to solve simple multiplication calculations and will write these as a number sentence. They will begin to understand that multiplication can be done in any order.	3 x 2 = 6 or 2 x 3 = 6 	arrays inverse equivalent lots of

<table>
<tr>
<td>Children will learn to use the grid method to solve multiplication calculations.

Children will partition numbers to multiply. They will use their understanding of place value to multiply multiples of 10.

This strategy will be used for all multiplication, including decimal numbers. Children may need to write a separate addition calculation if their grids extend beyond a single column.</td>
<td>
<table>
<tr><td>×</td><td>7</td></tr>
<tr><td>30</td><td>210</td></tr>
<tr><td>8</td><td>56</td></tr>
<tr><td></td><td>266</td></tr>
</table>
For long multiplication
<table>
<tr><td>×</td><td>20</td><td>7</td><td></td></tr>
<tr><td>50</td><td>1000</td><td>350</td><td>1350</td></tr>
<tr><td>6</td><td>120</td><td>42</td><td>162</td></tr>
<tr><td></td><td></td><td></td><td>1512</td></tr>
<tr><td></td><td></td><td></td><td>1</td></tr>
</table>
</td>
<td>grid
partition
hundreds
tens
units</td>
</tr>
<tr>
<td>Children will then be introduced to the expanded method of multiplication. This is only introduced when the children are confident with the grid method.</td>
<td>Expanded version using a multiplication grid.</td>
<td>arrays
inverse
equivalent
lots of</td>
</tr>
</table>

	$38 \times 7 = (30 \times 7) + (8 \times 7) = 210 + 56 = 266$  Vertical expanded version for multiplication by units: 46 x 8 46 x 8 320 (40 x 8) 48 (6 x 8) = 368	

Children will finally move onto the more efficient compact method of multiplication. Having gone through all of the above stages, children are confident with long multiplication.

These methods can be further developed by using bigger numbers (long multiplication) and decimals.

Examples of long multiplication
Children will then be introduced to the expanded method of multiplication. This is only introduced when the children are confident with the TU x U

Vertical compact version for multiplication by units:

eg 46 x 8

```
  46
x  8
 368
 4
```

Expanded method of long multiplication

```
  286
x  29
4000   200 × 20 = 4000
1600    80 × 20 = 1600
 120     6 × 20 =  120
1800   200 ×  9 = 1800
 720    80 ×  9 =  720
  54     6 ×  9 =   54
8294
1
```

thousands
hundreds
tens
units

	Compact version 286 × 29 5720 286 × 20 2574 286 × 9 8294 1 TU x TU Compact version 56 × 27 1120 56 × 20 392 56 × 7 1512 1	

Compact version of long multiplication:

eg

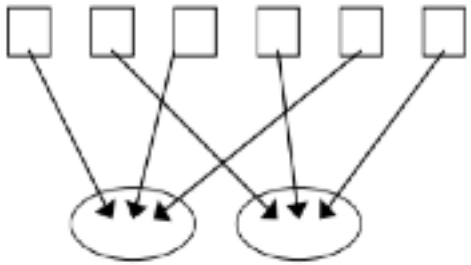
```
  72
  38
2160   (72 x 30)
 576   (72 x 8)
2736
 1
```

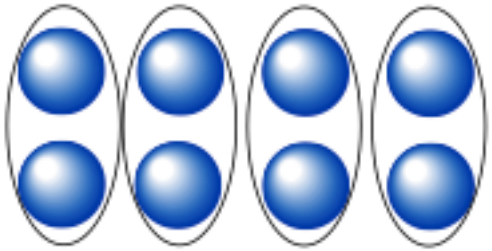
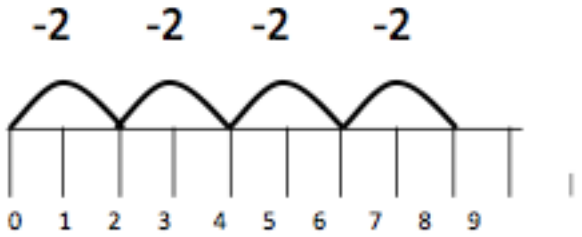
Grid method

×	20	9	
200	4000	1800	5800
80	1600	720	2320
6	120	54	174
			8294
			1

Division

Division		
Stages of learning	**Examples of what it looks like**	**Vocabulary**
Children will begin the process of division by sharing and grouping in an informal or practical manner.		sets of groups

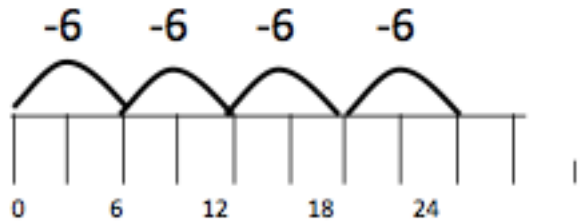
Children will begin to record their ideas using informal jottings to demonstrate either grouping or sharing.	**Sharing equally** 6 sweets shared between 2 people, how many do they each get?  **Grouping or repeated addition** There are 6 sweets, how many people can have 2 sweets each? 	sharing grouping

Children will relate division and multiplication facts describing them as being the inverse of each other. Arrays may be used to demonstrate this.	$8 \div 2 = 4$ 	arrays lots of sharing groups
Children will begin to use a number line to demonstrate division as repeated subtraction. They will initially use a numbered line and count down in the jumps to see how many 'lots of' that number there are.	$8 \div 2 = 4$ *Children will count the number of jumps that have been made.* 	lots of number line groups of dividing

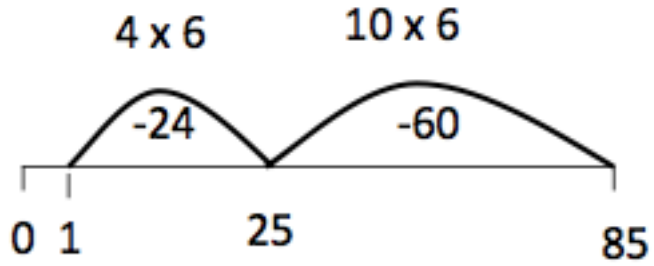
<table>
<tr>
<td>Children will use an empty number line to take out bigger chunks when dividing bigger numbers.

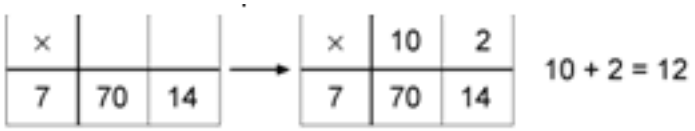
Children may need to use a separate subtraction calculation to support their repeated subtraction.</td>
<td>24 ÷ 6 = 4

Children will count the number of jumps that have been made.

 
</td>
<td rowspan="2">chunks
dividing
lots of
groups of</td>
</tr>
<tr>
<td>Children will develop their division number line work into the number line chunking method, taking out chunks of a number that you are dividing by.

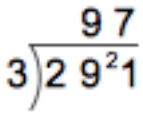
Children will use this for numbers going over ten times the divisor.</td>
<td>85 ÷ 6 = 14 r 1

 
</td>
</tr>
</table>

Children will also be taught and practise a number of mental division strategies using partitioning.	84 70 + 14 ÷7 ↓ ↓ 10 + 2 = 12 In this example, using knowledge of multiples, the 84 is partitioned into 70 (the highest multiple of 7 that is also a multiple of 10 and less than 84) plus 14 and then each part is divided separately using the distributive law. Another way to record is in a grid, with links to the grid method of multiplication.  10 + 2 = 12 As the mental method is recorded, ask: 'How many sevens in seventy?' and: 'How many sevens in fourteen?'	

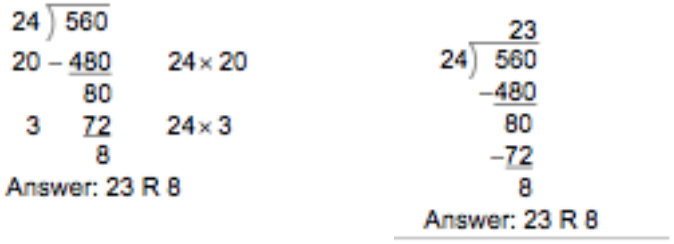
	Also record mental division using partitioning: $64 \div 4 = (40 + 24) \div 4$ $= (40 \div 4) + (24 \div 4)$ $= 10 + 6 = 16$ $87 \div 3 = (60 + 27) \div 3$ $= (60 \div 3) + (27 \div 3)$ $= 20 + 9 = 29$ Remainders after division can be recorded similarly. $96 \div 7 = (70 + 26) \div 7$ $= (70 \div 7) + (26 \div 7)$ $= 10 + 3\ R\ 5 = 13\ R\ 5$	

Children will condense the number line chunking strategy into a more efficient written method. To be able to master these methods effectively, children need to be able to multiply a single digit by any multiple of 10 in their head.	**'Expanded' method for TU÷U and HTU ÷ U** **Short division of TU ÷ U by chunking multiples of the devisor.** 72 ÷ 3 = 24 3 72 - 30 (10 x 3) 42 - 30 (10 x 3) 12 - 6 (2 x 3) 6 6 (2 x 3) 0 Answer = 24 **Short division of HTU ÷ U by chunking multiples of the devisor.** 196 ÷ 6 = 32 r 4 6 196 - 180 (30 x 6) 16 - 12 (2 x 6) 4 Answer = 32 r 4	chunks dividing lots of groups of multiples thousands hundreds tens units

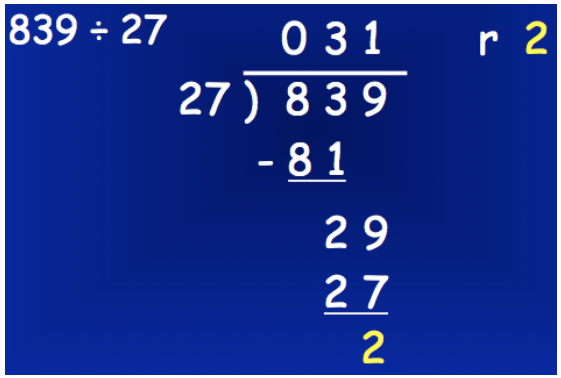
Short hand division methods (bus stop method) are also introduced at this stage. These methods can be further developed by using bigger numbers and decimals (you can express decimals as fractions).	 Any remainders should be shown as fractions, i.e. if the children were dividing 32 by 10, the answer should be shown as 3 $^{2}/_{10}$ which could then be written as 3 $^{1}/_{5}$ in its lowest terms. Extend to decimals with up to two decimal places. Children should know that decimal points line up under each other. 87.5 ÷ 7 = 12.5 7 87.5 - 70.0 (10 x 7) 17.5 - 14.0 (2 x 7) 3.5 - (0.5 x 7) 3.5 Answer = 0 12.5	

Long division

The next step is to tackle HTU ÷ TU using chunking.



Another method of long division using bus stop method.



These methods can be further developed by using bigger numbers and decimals (you can express decimals as fractions).