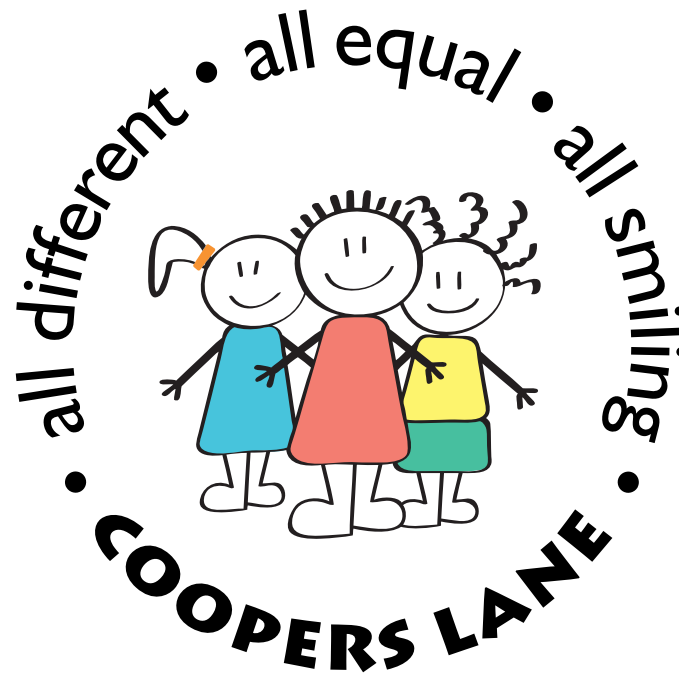

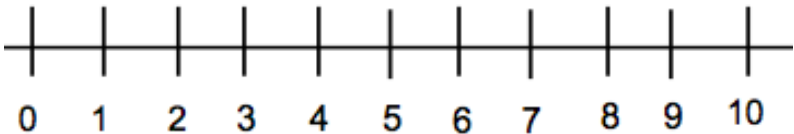





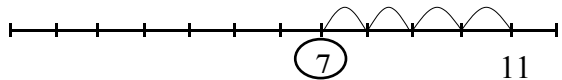
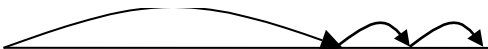

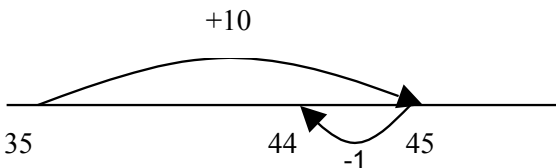
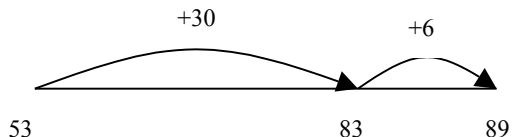
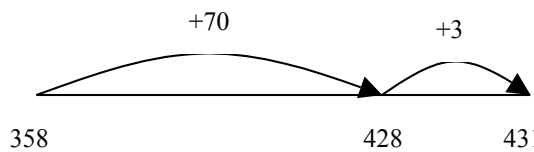
# Coopers Lane School



## **Whole School Written Calculation Policy Pencil and paper procedures Key Stages 1 and 2**

# PROGRESSION OF NUMBERLINES

<b>Number track</b>	Has the numbers inside the sections, rather than on the divisions	
<b>Calibrated, numbered numberline</b>	Equal divisions marked on the numberline and each division is numbered	
<b>Calibrated, unnumbered numberline</b>	Equal divisions are marked, but left unnumbered for children to add relevant numbers to	
<b>Blank numberline</b>	No divisions or numbers marked for the children	

Addition		
Stage 1	Stage 2	Stage 3
<p><b><u>+ = signs and missing numbers</u></b></p> $3 + 4 = \square \quad \square = 3 + 4$ $3 + \square = 7 \quad 7 = \square + 4$ $\square + 4 = 7 \quad 7 = 3 + \square$ $\square + \nabla = 7 \quad 7 = \square + \nabla$ <p>3 + 4 is the same as 7 as modelled using Numicon</p>  <p>Use Numicon to further understand the equivalence in a number sentence.</p> <p>Promoting covering up of operations and numbers.</p> <p><b><u>Number lines</u></b></p> <p>Using number lines</p> <p>(Teacher model number lines with missing numbers)</p> $7 + 4 = 11$  <p>Children go up in 1s</p> <p>Secure Stage 1 – able to use a hundred square</p>	<p><b><u>+ = signs and missing numbers</u></b></p> <p>Extend to</p> $14 + 5 = 10 + \square$ <p>and adding three numbers</p> $32 + \square + \square = 100 \quad 35 = 1 + \square + 5$ <p><b><u>Partition into tens and ones and recombine</u></b></p> $12 + 23 = 10 + 2 + 20 + 3$ $= 30 + 5$ $= 35$ <p><b>refine to partitioning the second number only:</b></p> $23 + 12 = 23 + 10 + 1 + 1$ $= 33 + 1 + 1$ $= 35$   <p><b><u>Mental Method</u></b></p> <p>Add 9 or 11 by adding 10 and adjusting by 1</p> $35 + 9 = 44$ 	<p><b><u>Partition into tens and ones and recombine</u></b></p> <p>Partition both numbers and recombine. Refine to partitioning the second number only e.g.</p> $36 + 53 = 53 + 30 + 6$ $= 83 + 6$ $= 89$  <p><b><u>Add a near multiple of 10 to a two-digit number</u></b></p> <p><b><u>Partition into hundreds, tens and ones and recombine</u></b></p> <p>Either partition both numbers and recombine or partition the second number only e.g.</p> $358 + 73 = 358 + 70 + 3$ $= 428 + 3$ $= 431$ 

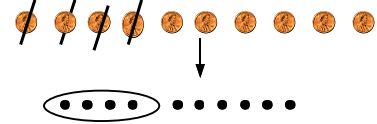
Addition		
Stage 4	Stage 5	Stage 6
<p><b>Pencil and paper procedures</b>  <math>36 + 43 = 79</math></p> <p>Partition both numbers  <math>36 = 30 + 6</math>  <math>43 = 40 + 3</math>  <math>79 = 70 + 9</math></p> <p>Recombine to get the answer  <math>30 + 40 = 70</math>  <math>6 + 3 = 9</math></p> <p>Leading to          Adding 3 digit numbers using the expanded method</p> <p> <math display="block">\begin{array}{r} 149 = 100 + 40 + 9 \\ + 35 = 30 + 5 \\ \hline 184 = 100 + 70 + 14 \end{array}</math> <i>Make sure you line up the H, T &amp; U</i>  <math>100 + 0</math> </p>	<p><b>Pencil and paper procedures</b>          Leading to formal method, showing numbers carried underneath</p> <p><b>Column Addition</b>          Column Addition will be taught alongside the Expanded Method to encourage children to see how they relate.</p> <p> <math display="block">\begin{array}{r} 123 = 100 + 20 + 3 \\ + 45 = 40 + 5 \\ \hline 168 = 100 + 60 + 8 \end{array}</math> <i>Is the same as:</i> <math display="block">\begin{array}{r} \text{HTU} \\ 123 \\ + 45 \\ \hline 168 \end{array}</math> </p> <p><b>Column Addition with carrying</b></p> <p> <i>Remember to line up the HTU.</i> <math display="block">\begin{array}{r} \text{HTU} \\ 467 \\ + 215 \\ \hline 682 \\ \hline 1 \end{array}</math> <i>Because <math>7 + 5 = 12</math> we have to carry the 10.</i> </p> <p>Extend to numbers with at least four digits  <math>3587 + 675 = 4262</math></p> <p> <math display="block">\begin{array}{r} 3587 \\ + 675 \\ \hline 4262 \\ \hline 111 \end{array}</math> </p> <p>Extend to decimals (same number of decimals places) and adding several numbers (with different numbers of digits).          Model negative numbers using a number line.</p>	<p><b>Column Addition.</b>          Children should be comfortable with using column addition to add 4 digit numbers and several numbers with different numbers of digits at the same time.</p> <p> <math display="block">\begin{array}{r} \text{Th H T U} \\ 5678 \\ + 468 \\ \hline 6218 \\ \hline 121 \end{array}</math> <i>Ensure that the digits are lined up correctly.</i>  <i>Carry below the line.</i> </p> <p>Adding decimals using column addition.</p> <p> <math display="block">\begin{array}{r} \text{TU} \cdot \frac{1}{10} \\ 35.2 \\ + 16.0 \\ \hline 51.2 \end{array}</math> <i>Carry below the line.</i>  <i>Add '0' as a place holder</i> </p>

# Subtraction

## Stage 1

### Pictures / marks

Sam spent 4p. What was his change from 10p?



### - = signs and missing numbers

$$\begin{aligned} 7 - 3 &= \square & \square &= 7 - 3 \\ 7 - \square &= 4 & 4 &= \square - 3 \\ \square - 3 &= 4 & 4 &= 7 - \square \\ \square - \nabla &= 4 & 4 &= \square - \nabla \end{aligned}$$

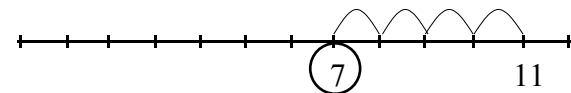
### Visual / practical activities

#### Number lines

The difference between 7 and 11

(Counting on)

To reinforce concept. Practical strategies essential to see 'difference'.



Recording by - drawing jumps on prepared lines  
- constructing own lines, if appropriate

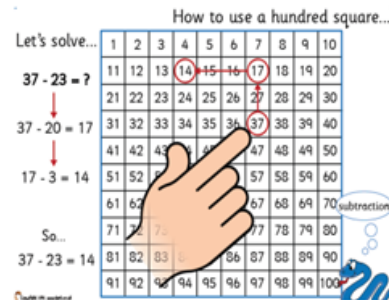
(Teachers model jottings appropriate for larger numbers)

## Stage 2

### - = signs and missing numbers

Continue using a range of equations as in Stage 1 but with appropriate numbers.

Using a Hundred Square:



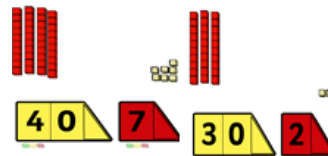
When children are ready to subtract larger numbers they will do so on a hundred square.

They will be encouraged to up in jumps of 10s and back in jumps of units.

Children are encouraged to then record this as a sum.

Leading to:

$$47 - 32 =$$



$$40 - 30 = 10$$

$$7 - 2 = 5$$

$$10 + 5 = 15$$

When children are confident in using a hundred square and have a good understanding of place value, they can then begin to partition.

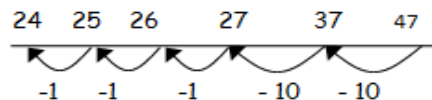
This involves partitioning the numbers into 10s and units and subtracting these. Then recombining the 10s and units to get an answer.

Children will begin to use blank number lines to support calculations.

### Counting back

First counting back in tens and then in ones.

$$47 - 23 = 24$$



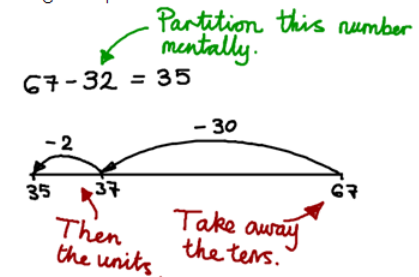
## Stage 3

### Find a small difference by counting on

Continue as in Stage 2 but with appropriate numbers e.g.  $102 - 97 = 5$

### Counting back using a number line.

We will be using a number line to count back from the biggest number using partitioning to help.



**Note:** Counting back is not always the most efficient method when the numbers are closer together.

# Subtraction

## Stage 4

The Expanded Method of Subtraction.

Partitioning both numbers leads to the opportunity to use more formal methods of subtraction.

Partition both numbers.  $67 = 60 + 7$  line up the tens and units.  
 $-32 = 30 + 2$   
 $67 - 32 = 35$   
 $35 = 30 + 5$   
 $7 - 2 = 5$   
 $60 - 30 = 30$   
 Recombine to get the answer.

The Expanded Method of Subtraction with carrying.

$62 = 50 + 12$  We exchange 1 ten for 10 units.  
 $62 = 50 + 12$   
 $-35 = 30 + 5$   
 Write these numbers above.  
 $27 = 20 + 7$

## Stage 5

Pencil and paper procedures

$$\begin{array}{r} 8 \phantom{0} 1 \\ 92 \\ - 38 \\ \hline 54 \end{array}$$

Develop the stages of decomposition introducing 'zero'

$$\begin{array}{r} 2 \phantom{0} 4 \phantom{0} 1 \\ 352 \\ - 178 \\ \hline 174 \end{array} \quad \begin{array}{r} 4 \phantom{0} 9 \phantom{0} 9 \phantom{0} 1 \\ 5000 \\ - 457 \\ \hline 4543 \end{array}$$

## Stage 6

Column Subtraction.

Children will move on to using Column Subtraction on its own and with larger numbers.

Exchange with the next digit.  
 $3000 - 0 = 3000$   
 $150 - 60 = 90$   
 Start subtracting from the units  
 Subtracting decimals using Column Subtraction.  
 $16.5 - 17.0$   
 Exchange with the next digit.  
 $2 - 1 = 1$   
 $16 - 9 = 7$   
 line up the H, T &  $\frac{1}{10}$   
 Add '0' as a place holder.

Develop the use of decomposition

extend to up to 2 decimal places

$$\begin{array}{r} 48.42 - 37.61 = \\ 48.42 \\ - 37.61 \\ \hline 10.81 \end{array}$$

extend to up to 3 decimal places if appropriate

$302.63 - 178.124 =$

$$\begin{array}{r} 2 \phantom{0} 9 \phantom{0} 1 \\ 302.630 \\ - 178.124 \\ \hline 124.506 \end{array}$$

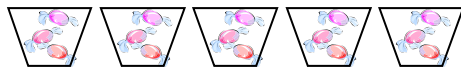
# Multiplication

## Stage 1

### Pictures and symbols

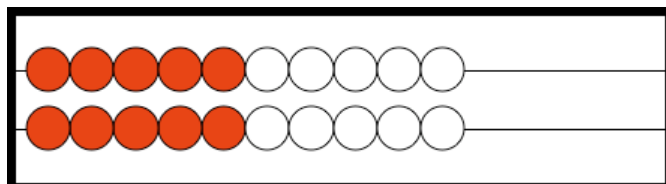
There are 3 sweets in one bag.

How many sweets are there in 5 bags?



(Recording on a number line modelled by the teacher when solving problems)

Use of bead strings to model groups of.



Use cubes and pegs. Begin to learn 2, 5 and 10 times tables.

## Stage 2

### x = signs and missing numbers

$$7 \times 2 = \square \quad \square = 2 \times 7$$

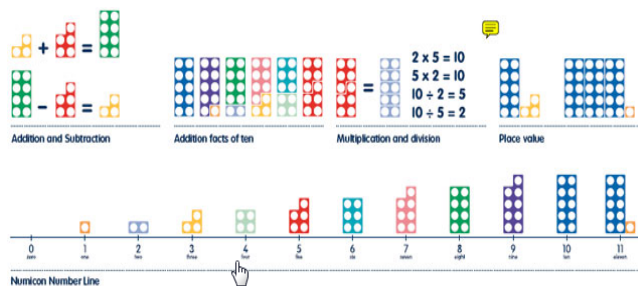
$$7 \times \square = 14 \quad 14 = \square \times 7$$

$$\square \times 2 = 14 \quad 14 = 2 \times \square$$

$$\square \times \nabla = 14 \quad 14 = \square \times \nabla$$

### Arrays and repeated addition

$$\begin{array}{cccc} \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \end{array} \quad 4 \times 2 \text{ or } 4 + 4$$



$$2 \times 4$$

or repeated addition

$$2 + 2 + 2 + 2$$



0 1 2 3 4 5 6 7 8

### Doubling multiples of 5 up to 50

$$15 \times 2 = 30$$

Partition

$$(10 \times 2) + (5 \times 2)$$

$$20 + 10 = 30$$

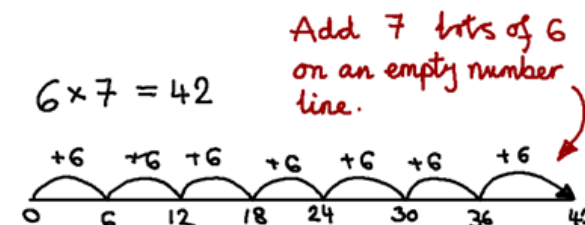
## Stage 3

### x = signs and missing numbers

Continue using a range of equations as in Stage 2 but with appropriate numbers.

Repeated addition using a number line.

Understanding multiplication as repeated addition is key to understanding formal methods of multiplication.



$$35 \times 2 = 70$$

Partition using Grid Method

x	30	5
2	60	10

## Multiplication

### Stage 4

#### Pencil and paper procedures

Grid method

TU x U

23 x 7 is approximately 20 x 10 = 200

$$23 \times 7 = 161$$

	T	U
x	20	3
7	140	21

HTU x U

$$123 \times 3 = 369$$

	H	T	U
x	100	20	3
3	300	60	9

### Stage 5

x = signs and missing numbers

#### Pencil and paper procedures

Grid method

72 x 38 is approximately 70 x 40 = 2800

x	70	2	
30	2100	60	= 2160
8	560	16	= 576 +
			<u>2736</u>
			1

Estimate and check

Moving on to formal method when appropriate.

'Carried' numbers to sit on top line of answer box

$$1125 \times 7 = 7875$$

	Th	H	T	U
x	1000	100	20	5
7	7000	700	140	35

Accept formal compact method for the individual pupils that it works for

	7	2
x	3	8
2	1	6
	5 <sub>1</sub>	7
2	7 <sub>1</sub>	3
		6

### Stage 6

x = signs and missing numbers

Pencil and paper procedures

Grid method for decimals

Multiplying decimal numbers using the grid method.

x	5	+	0.2	
6	30	+	1.2	= 31.20
0.3	1.5	+	0.06	= 1.56
				<u>32.76</u>

*0.3 x 0.2*

*Take care to line up the digits. Adding a place holder will help.*



## Division

### Stage 1

#### Pictures / marks

12 children get into teams of 4 to play a game.  
How many teams are there?



Use practical resources – cubes, counters, children etc

### Stage 2

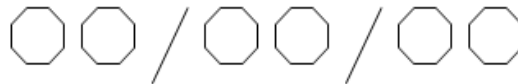
#### ÷ = signs and missing numbers

$$\begin{array}{ll} 6 \div 2 = \square & \square = 6 \div 2 \\ 6 \div \square = 3 & 3 = 6 \div \square \\ \square \div 2 = 3 & 3 = \square \div 2 \\ \square \div \nabla = 3 & 3 = \square \div \nabla \end{array}$$

#### Understand division as sharing and grouping

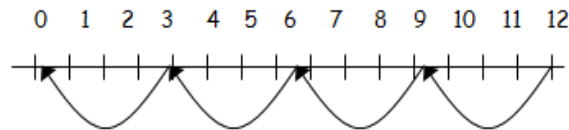
##### Grouping or repeated subtraction

There are 6 sweets, how many people can have 2 sweets each?



##### Repeated subtraction using a number line and bead bar

$$12 \div 3 = 4$$



### Stage 3

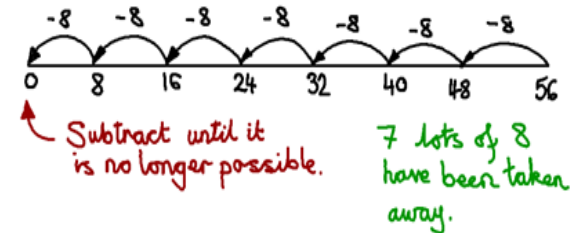
#### ÷ = signs and missing numbers

Continue using a range of equations as in Stage 2 but with appropriate numbers.

#### Understand division as sharing and grouping

Understanding division as repeated subtraction is key to understanding formal methods of division.

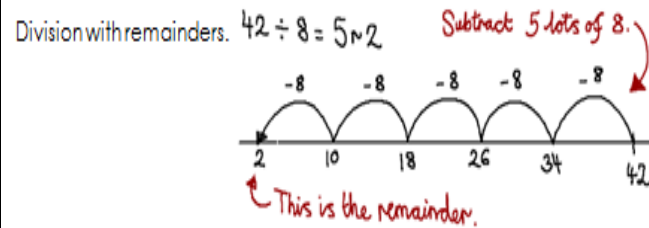
$$56 \div 8 = 7 \quad \text{Repeatedly subtract 8.}$$



## Division

### Stage 4

$\div$  = signs and missing numbers



### Stage 5

$\div$  = signs and missing numbers

#### Remainders

Next Steps:

Chunking with remainders.

$$76 \div 8 = 9 \text{ r } 4$$

This is the remainder.

#### Remainders

Quotients expressed as fractions or decimal fractions  
 $676 \div 8 = 84.5$

Chunking using times table facts.

Children will continue to explore division as repeated subtraction. They will use their increasing knowledge of times tables to subtract in larger chunks.

$$128 \div 7 = 18 \text{ r } 2$$

Use the 10 times table to subtract lots of 7.

Subtract using known times table facts.

The remainder.

### Stage 6

$\div$  = signs and missing numbers

Chunking using times table facts and multiples of 10.

Using their knowledge of the 10 times table will allow children to divide larger numbers by two-digit numbers while reducing the number of steps.

$$197 \div 12 = 16 \text{ r } 5$$

Subtract using known times table facts.

10 + 5 + 1 = 16 lots of 12 have been taken away.

Expressing the remainder as a fraction.

$$50 \div 4 = 12 \text{ r } 2$$

The remainder.

$$= 12 \frac{2}{4}$$

The divisor.

This can then be converted into a decimal.