Edinburgh Primary School Calculation policy

This policy aims to make clear the progression in calculation methods for the four operations. The guidance within this policy was taken from the suggested progression in calculation methods distributed by the borough of Waltham Forest for previous curriculum content. All classes across the school must follow the guidance set out in this policy in order to maintain a consistent approach throughout. Children must work through the steps in order to be confident with more formal methods that must now be introduced at key year groups in line with the New 2014 curriculum.

At times, children come in to new classes/ year groups having been taught more advanced methods at home or in a previous school. If a child is confident with the method and able to explain clearly how the method works using correct place value terminology, then they should not be discouraged from using their method.

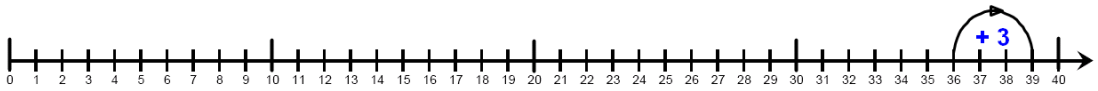
If, however, they cannot explain their method and/or frequently make errors when using it, take them back to an appropriate method in line with other children working at the same level.

Naturally, all formal calculation methods will rely heavily on secure place value, number bond and times table knowledge so there should be opportunities to practise these skills regularly.

1) Addition

Early methods: Children need to understand addition as 'counting on' in any order:

- **Add** mentally a single digit number to a single digit number without crossing 10 e.g. 2 + 4
  - Count on in 1's from the smaller or the larger number –*using a number track or bead string.*
- **Add** mentally a single digit number to a teens number without crossing ten e.g. 16 + 2
  - *Count on in ones from the teen number using a number track or a bead string.*
- **Add** mentally a single digit number to a two-digit number without crossing ten e.g. 36 + 3
  - *Count on in ones using a number track or a bead string.*



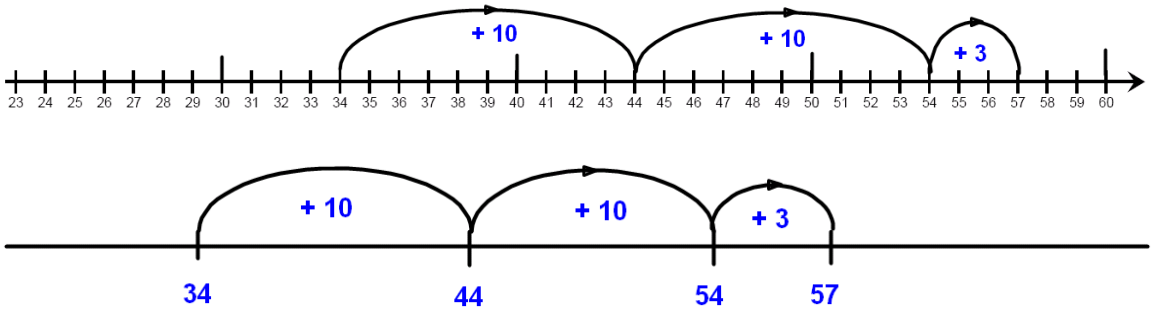
- **Add** mentally a single digit number to a two-digit number crossing ten e.g. 27 + 6
  Count on in ones using a number track or a bead string.
  - Count on in steps of different sizes appropriate to the sum
    e.g. 27+ 3 → 30, 30+1+1+1=33

- **Add** mentally a single digit to ten, then 20 e.g. 10 + 4, 20 + 4
  - *Count on in ones from the multiple of ten first using a number track then bead string.*

Stage 1: number lines

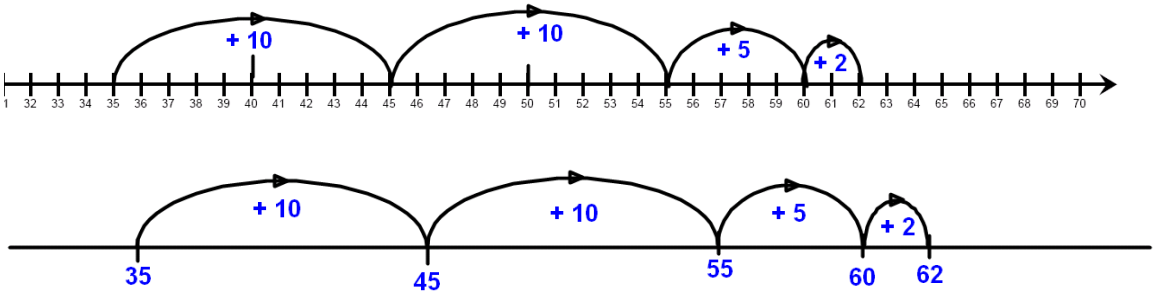
- **Add** pairs of two digit numbers [not crossing the tens]
  - Count on in steps of ten and then in steps of different sizes appropriate to the sum.

  E.g. 23+34 = 34+10+10+3, *first using a bead string, then a numbered number line, extending where appropriate to an empty number line.*

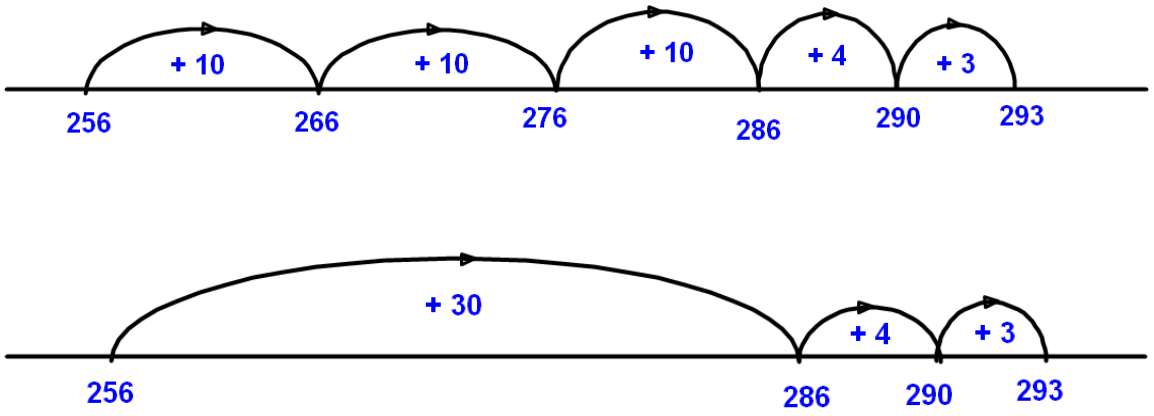


- **Add** pairs of two digit numbers [crossing the tens]
  - Count on in steps of ten and then in steps of different sizes appropriate to the sum.

  E.g. 27+35= 35+10+10+5+2, *first using a bead string, then a numbered number line, extending where appropriate to an empty number line.*



HTU +TU e.g. **256+37** [not crossing the hundred], progressing to crossing the hundred.



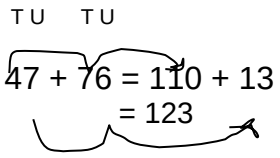
<u>Stage 2:</u> Mental method, using partitioning:

The mental method to which written methods most closely relate involves partitioning, adding the tens and units separately. Initially carried out with jottings then mentally.

e.g. 47 + 76 = (40 + 70) + (7 + 6) *leading to*

= 110 + 13

= 123



<u>Stage 2:</u> Vertical layout, expanded working, moving from adding the most significant digit first to adding the least significant digit first: <u>Year 3 need to begin using this method of recording so that children are becoming confident by the end of Year 3..</u>

The next step is to show children the vertical format (units under units, tens under tens, etc.) and link it to the mental method. <u>They first practise this method with calculations they can do mentally,</u> and then extend to three-digit numbers, which provides justification for developing a written method.
**An important point is that children should be able to describe what they are doing by referring to the actual values of the digits in the columns i.e. '20 + 50' or '2 tens + 5 tens', <u>never</u> '2 + 5'.*

e.g. 47 + 76

a) Adding the most significant digits first

leading to

b) Adding the least significant digits first

47		47	
<u>+ 76</u>		<u>+ 76</u>	
110	(40 +70)	13	(7+6)
<u>13</u>	(7+6)	<u>110</u>	(40 +70)
123		123	

<u>Stage 3:</u> Vertical layout, contracting the working to a compact, efficient form: <u>by end of Year 4</u>,

children should be confident with this method.

A conventional compact, efficient method, with carrying below the line, is introduced by linking it directly to the expanded method, starting with the units. Children should be able to explain the link and appreciate that the compact method saves time recording their working. If, with a little practice, they cannot use the compact method without making errors, they should return to the expanded format.
**Again, when describing each step, <u>children should refer to the actual values</u> of the digits.*

47	to	47
+ <u>76</u>		<u>+ 76</u>
13		<u>123</u>
<u>110</u>		11
123		

<u>Stage 4:</u> Extend to bigger numbers and decimals:

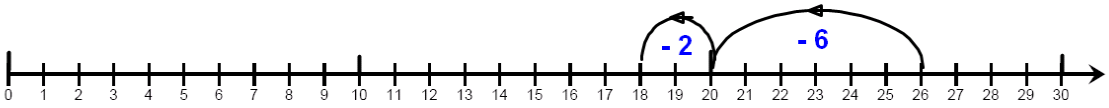
When returning to written calculations at a later stage, e.g. to revise or to extend to decimals or numbers with more digits, it is a good idea to start again with informal, expanded methods. This helps children to retain their understanding of the link between different methods, and makes it easier for them to resort to an expanded method if they need to do so.

2) Subtraction

Early methods Children need to understand subtraction as 'take away' and find a difference by counting up:

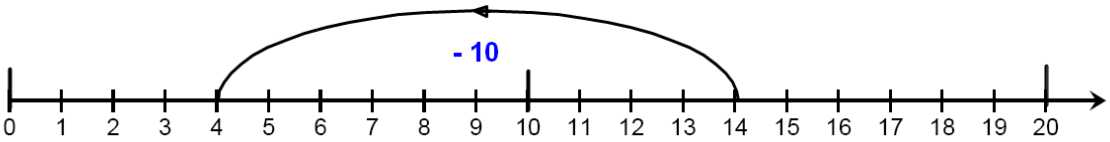
- **Subtract** mentally a single digit number from a single digit number without crossing 10
  - Count on in 1's from the smaller to the larger number to find a difference. E.g. 8 – 7, *using a number track or bead string.*
  - *Count back in ones to 'take away. E.g. 8-3, using a number track or a bead string.*
- **Subtract** mentally a single digit number from a teens number without crossing ten
  - *Count back in ones to 'take away' using a number track or a bead string.* E.g. 17-4

- **Subtract** mentally a single digit number from a two-digit number without crossing ten
  - *Count back in ones to 'take away' using a number track or a bead string.* e.g. 26-4
- **Subtract** mentally a single digit number from a two-digit number crossing ten e.g. 26- 8 *Count back in ones to 'take away' using a number track or a bead string.*
  - Count back in steps of different sizes appropriate to the sum e.g. 26- 8= 26 – 6 – 1 – 1 ,progressing to count on to the next ten and then one more step e.g. 26- 8=26- 6 – 2 *using a number track, or a bead string, extending where appropriate to a numbered number line*



- **Subtract** mentally a single digit from ten, then 20,
  - *Count back in ones to 'take away' first using a number track then bead string.* E.g. 20-5
  - ***OR*** Count on in 1's from the smaller to the larger number to find a difference– *first using a number track then bead string.* E.g. 10-7

- **Subtract** 10 from a teens number e.g. 14 – 10
  - *Count back a ten to 'take away' first using a bead string then a number line.*



- **Subtract** 10 from a two-digit number e.g. 32 – 10
  - *Count back a ten to 'take away' first using a bead string then a number line.*

Stage 1 Year 3 should begin using this method and children should be confident by the end of year 4.

Show the children the vertical layout for a calculation they can do mentally. Link the steps to those on an empty number line.

e.g. 74 – 27

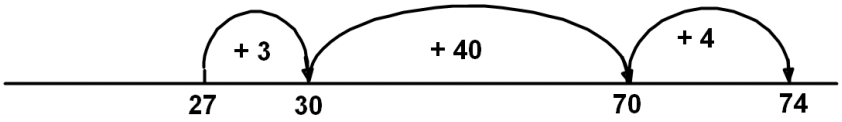
74
- 27

3 (→ 30)

40 (→ 70)

4 (→ 74)

47



Stage 2

Show how this form of recording can help organise the steps involve in subtracting a three-digit number from another three-digit number

e.g. 326 - 178

326
- 178

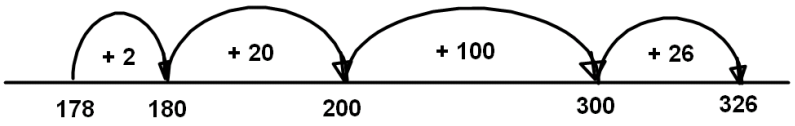
2 (→ 180)

20 (→ 200)

100 (→ 300)

26 (→ 326)

148



You can reduce the number of stages further, by using knowledge of pairs of numbers that total 100.

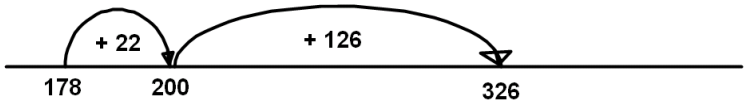
326

- 178

22 (→ 200)

126 (→ 326)

148



Stage 3

Extend to bigger numbers and decimals.

e.g. 22.4 – 17.8

22.4

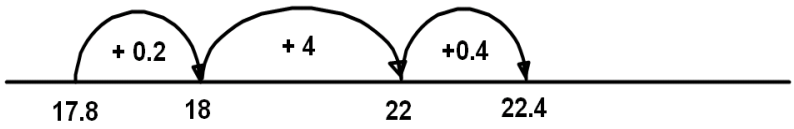
- 17.8

0.2 (→ 18)

4.0 (→ 22)

0.4 (→ 22.4)

4.6



Stage 4 This method should only be used once children are confident with the previous complimentary addition processes. Decomposition needs to be introduced in Year 5 if not previously encountered. Note: Some children find this method confusing so should be supported with practical diennes equipment. Teachers may use their judgement to skip this step and move straight to compact method if necessary.

The expanded vertical method of decomposition involves partitioning and repartitioning. The subtraction calculation is carried out in columns, starting with the least significant digits (the units).

e.g. 263 – 141

200 + 60 + 3
- 100 + 40 + 1
100 + 20 + 2 = 122

leading to 'repartitioning' tens to subtract larger numbers of units from smaller ones

eg. 342 – 126

30 12
300 + 40 + 2
- 100 + 20 + 6
200 + 10 + 6 = 216

progressing through the stages of repartitioning, until repartitioning tens and hundreds

e.g. 725 – 367

110
600 10 15
700 + 20 + 5
- 300 + 60 + 7
300 + 50 + 8 = 358

Stage 5: Standard compact method of decomposition

A conventional compact, efficient method, with carrying below the line, is introduced by linking it directly to the expanded method, starting with the units. Children should be able to explain the link and appreciate that the compact method saves time recording their working. If, with a little practice, they cannot use the compact method without making errors, they should return to the expanded format or to counting up on a number line.

**Again, when describing each step, children should refer to the actual values of the digits.*

e.g. 725 – 367

6 11 2 15
7 2 5
- 3 6 7
3 5 8

<u>Stage 3:</u> Extend to bigger numbers and decimals

When returning to written calculations at a later stage, e.g. to revise or to extend to decimals or numbers with more digits, it is a good idea to start again with informal, expanded methods. This helps children to retain their understanding of the link between different methods, and makes it easier for them to resort to an expanded method if they need to do so.

3) Multiplication

Early methods:

1)

- Count on in ones, twos, fives and tens and use this knowledge to derive the multiples of 2, 5, and 10 to the tenth multiple.
- Solve practical problems that involve combining groups of 2, 5 or 10.

2)

- Derive and recall multiplication facts for the two, five and ten times table.
- Represent repeated addition and arrays as multiplication; use practical and informal written methods and related vocabulary to support multiplication.
  Use the symbols X and = to record and interpret number sentences, calculate the value of an unknown in a number sentence (e.g. □ x 2 =12)

<u>Stage 1:</u> Mental method, using partitioning:

$38 \times 7 = (30 \times 7) + (8 \times 7)$
$= 210 + 56$
$= 266$

<u>Stage 2:</u> Grid method, expanded working: <u>This method should begin to be used throughout the year in Year 3 and children should be confident by the end of year 4.</u>

The mental method from which written methods are developed involves partitioning, and then multiplying the tens and ones separately. It is common to start with the tens when working mentally. A useful way of recording intermediate steps is the 'grid' method. This relates to finding the area of a rectangle.

×	30	8
7	30 x 7 = 210	8 x 7 = 56

Stage 3: Extended to bigger numbers

e.g. 56 × 27
Estimate: 1800 because 60 × 30 = 1800
56 × 27 = (50 + 6) × (20 + 7)

×	50	6
20	50 x 20 = 1000	6 x 20 = 120
7	50 x 7 = 350	6 x 7 = 42

1000 + 350 + 120 + 42 = 1512

Stage 4: Extended to decimals

e.g. 23.5 × 12
Estimate: 25 × 10 = 250
23.5 × 12 = (20 + 3 + 0.5) × (10 + 2)

x	20	3	0.5
10	20 x 10 = 200	3 x 10 = 30	0.5 x 10 = 5
2	20 x 2 = 40	3 x 2 = 6	0.5 x 2 = 1

200 + 40 + 30 + 6 + 5 + 1
= 282

Stage 5: Vertical format, expanded working. Introduce in Year 5 if not already encountered.

Eventually, children may be introduced to a vertical format. They should first practise this with calculations they can do mentally. They can also investigate starting with the ones first rather than the tens. Children should describe what they do by referring to the actual values of the digits in the columns. The method is then extended to multiplying by two-digit numbers.

```
  38
× 7
 210   (30 × 7 =210)
  56    (8 × 7 =  56)
 266
```

link to the grid method:

x	30	8
7	30 x 7 = 210	8 x 7 = 56

```
  56
× 27
1000  (50 × 20 =1000)
 120   (6 × 20 =  120)
 350   (50 × 7 =  350)
  42   (6 × 7 =    42)
1512
 1
```

link to the grid method:

x	50	6
20	50 x 20 = 1000	6 x 20 = 120
7		

Stage 6: Vertical format, compact working

The method is made more compact by combining steps. If after practice, children cannot use the compact method without making errors, they should return to the expanded format.

38	56	link to the grid method:
× 7	x 27	
266	1120	(56 x 20)
5	392	(56 x 7)
	1512	
	1	

4) Division

Early progression:

- Count aloud in ones, twos, fives or tens.
- Share objects into equal groups and count how many in each group

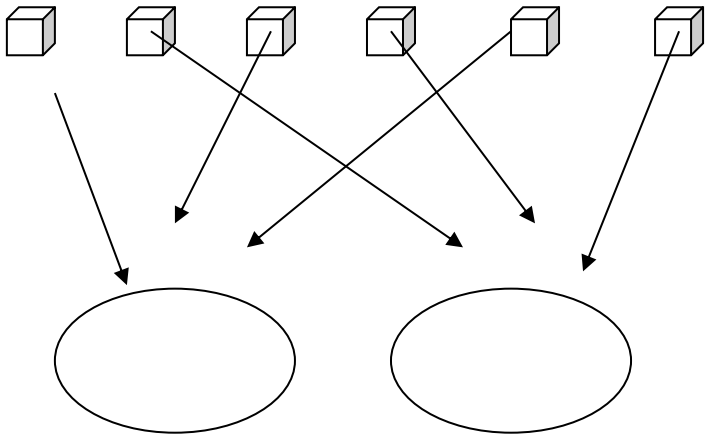
- Count back in ones, twos, fives and tens.
- Solve practical problems that involve combining groups of 2, 5 or 10, or sharing into equal groups.

Stage 1:

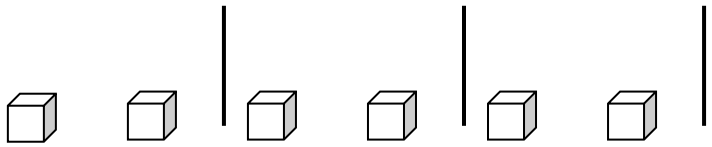
Understanding division as:

- **Sharing equally** *occurs when a quantity is shared out equally into a given number of portions, and we can work out how many are in each portion.*

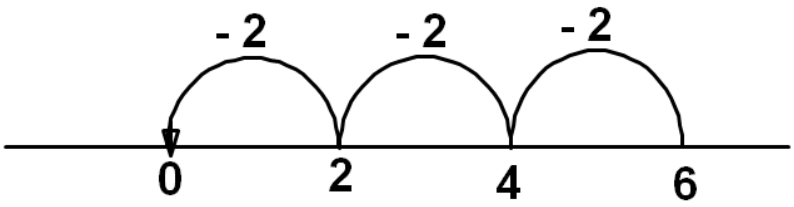
e.g. 6 ÷ 2 (share 6 sweets between 2 children)



- **Grouping (or repeated subtraction)** *occurs when we are asked to find how many groups of a given size are equivalent to the original quantity. For example how many groups of 2 marbles are in a set of 6 marbles, the calculation*
  6 ÷ 2 (how many 2s in 6?)



Shown/calculated on a number line:



IT IS VITAL THAT WE TEACH ALL THE ABOVE METHODS OF DIVISION, INCLUDING REPEATED SUBTRACTION, TO ENABLE CHILDREN TO UNDERSTAND METHODS TAUGHT LATER ON.

<u>Stage 2:</u> Informal written methods – *subtracting multiples of the divisor ('chunking')*

Using key facts, a simple way of subtracting multiples of the divisor, using known times-table facts.

<u>Key facts:</u> x10

x5

x2

x1

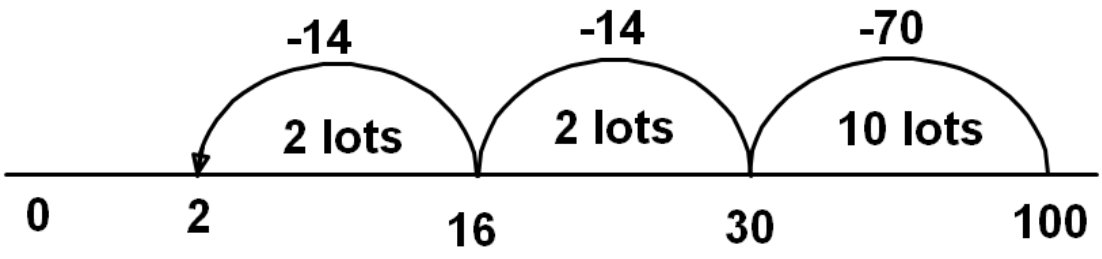
e.g. 100 ÷ 7 = 14 r 2

<u>Key facts:</u> 7 × 10 = 70

7 × 5 = 35

7 × 2 = 14

7 × 1 = 7



On a number line:

<u>Stage 3:</u> Progressing to an expanded vertical method: <u>By the end of Year 4, children should be becoming confident with this method for division.</u>

e.g. 234 ÷ 13

	234		
-	130	13 x (10)	
	104		
-	65	13 x (5)	
	39		
-	26	13 x (2)	
	13		
-	13	13 (x 1)	→ 234 ÷ 13 = 18

Help Box
13 x 10 = 130

13 x 5 = 65

13 x 2 = 26

<u>Stage 4: Throughout year 5 and 6, methods of short division or "bus stop" method are to be introduced</u>

Stage 5: If children are very confident, methods of long division can be taught in <u>year 6</u> but chunking works just as well and, as long as children are secure with times tables, can be just as efficient.

Policy compiled by A. Goodwin November 2012

Reviewed by A. Spencer January 2014

Re written by A. Spencer to link to New Curriculum March 2015

Reviewed by A.Spencer October 2016