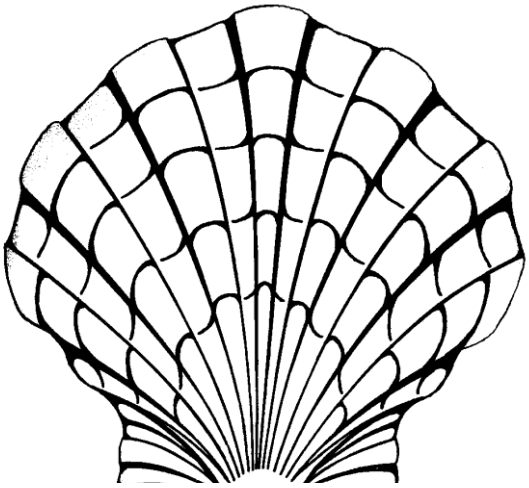
NAZEING PRIMARY SCHOOL



MATHEMATICS CALCULATION POLICY

Nazeing Primary School is committed to the lively and engaging delivery of mathematics across the age ranges and curriculum. For children to access the majority of their learning in numeracy, a strong and confident grasp of the four number operations is important; for formal and informal written methods and mental strategies. This policy blends current practices with the expectations of the national strategy. The ultimate decision to move a child onto a new method of calculation lies with the teacher and rests on the student feeling confident and secure with the method they currently rely upon.

Ongoing practice:

- Children should be encouraged to estimate before calculating an answer.
- Children should be given the opportunities to determine if a calculation can be done in their head or using a written method.
- Children should check their answer (e.g. by using the inverse operation).
- Children should practice their multiplication facts until they know them off by heart.
- Teachers should move children on when it is appropriate.
- Teachers should encourage children to use alternative, secure methods to check their answers and draw links.
- Teachers should use models and images to support the learning of written and mental methods of calculation.
- Mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing.
- Written recording both helps children to clarity their thinking and supports and extends the development of more fluent and sophisticated mental strategies.
- The long-term aim is for children to be able to select an efficient method of their choice that is appropriate for a given task.

Transition in stages of addition

1. Handling objects by combining groups of objects for early addition

2. Pictorial and physical handling of objects for addition

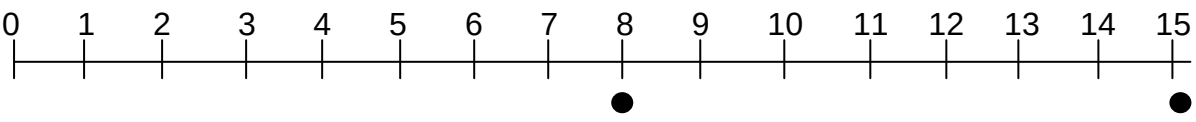
3. Use of a variety of number lines or tracks

= 5

The Number Line and Number Square

Children are encouraged to use a number square and number line to add by counting on, initially in units, then in tens and units.

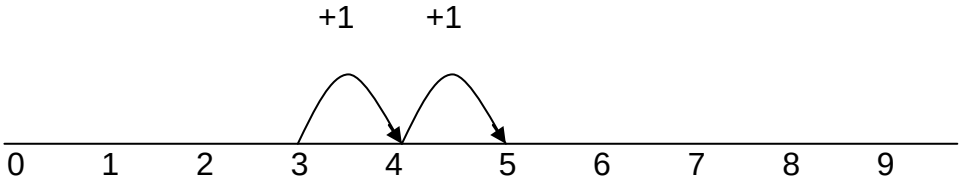
8 + 7 = 15



Written number line (see below for transition within this method).

Count in ones

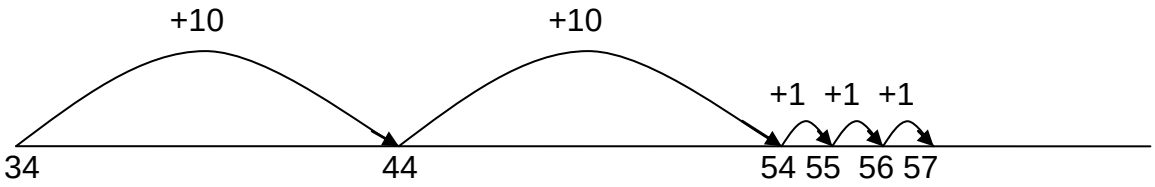
3 + 2 = 5



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

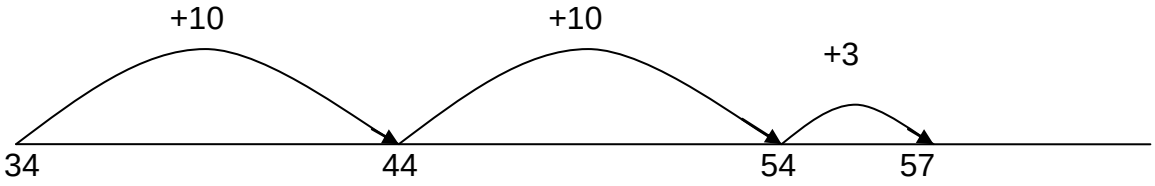
Counting on in tens and ones

34 + 23 = 57



Grouping ones

34 + 23 = 57

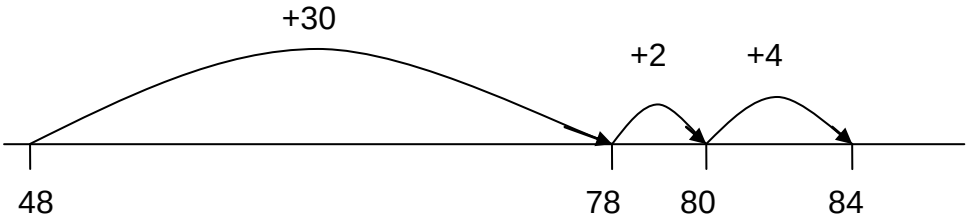


Grouping Tens

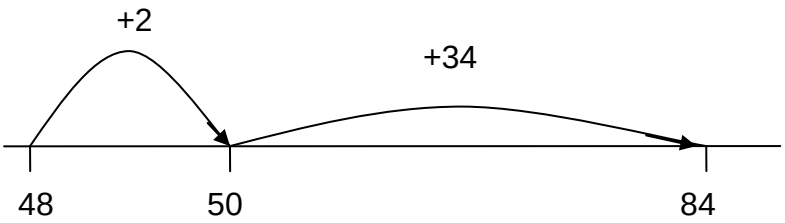
48 + 36 = 84

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

48 + 36 = 84



OR



- Children need to know that addition can be done in any order (commutative) and be able to solve missing number problems.

Partitioning

The next stage is to record mental methods using partitioning. Add the tens and then the units to form partial sums and then add these partial sums.

46 + 76

40 + 70 = 110

7 + 6 = 13

110 + 13 = 123

Which is then recorded in a shorter form below

47 + 76 = 110 + 13 = 123

Partitioned numbers are then written under one another:

$$\begin{array}{r} 47 = 40 + 7 \\ +76 = 70 + 6 \\ \hline 110 + 13 \end{array} + 123$$

Expanded method in columns for the formal written method

Move on to a layout showing the addition of the tens to the tens and the units to the units separately. At this stage, ask the children to always start by adding the units first. This is very important as it will need to be done in this order when moving onto the compact method.

The addition of the tens in the calculation 47 + 76 is described in words 'forty plus seventy equals one hundred and ten', stressing the link to the related fact 'four plus seven equals eleven'.

$$\begin{array}{r} 47 \\ +\ 76 \\ \hline 13 \\ \underline{110} \\ 123 \end{array}$$

Formal written method – column addition

In this method, recording is reduced further. Carry digits are recorded below the line, using the words 'carry ten' or 'carry one hundred', not 'carry one'.

$$\begin{array}{r} 47 \\ +\ 76 \\ \hline \underline{123} \\ 11 \end{array}$$

Later, extend to adding three two-digit numbers, two three-digit numbers and numbers with different numbers of digits.

$$\begin{array}{r} 366 \\ +\ 458 \\ \hline \underline{824} \\ 11 \end{array}$$

The same method can then be applied when adding decimals.

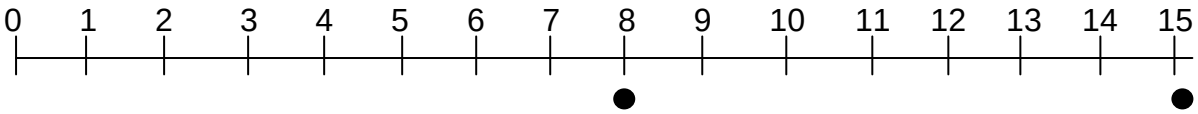
Transition in stages of subtraction

1. Handling objects by removing for subtraction
2. Pictorial and physical handling of objects of addition
3. Use of blank number lines

= 5

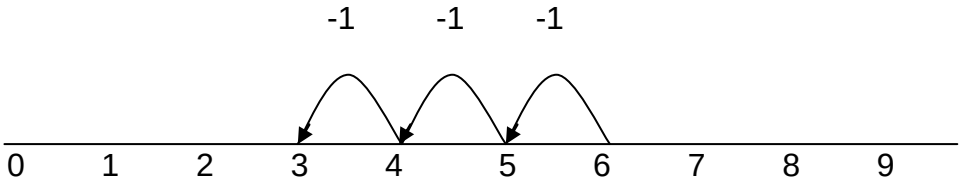
Counting backwards using the number line

15 - 7 = 8



Counting in ones

6 - 3 = 3

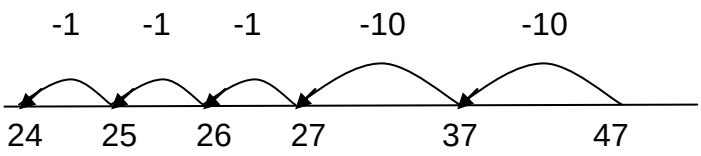


15 - 7 = 8

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Counting back in tens and ones

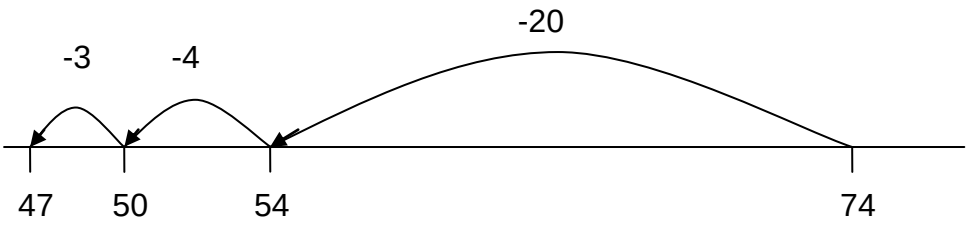
47 - 23 = 24



74 - 27 = 47

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

74 - 27 = 47



The steps backwards may be recorded in any order.

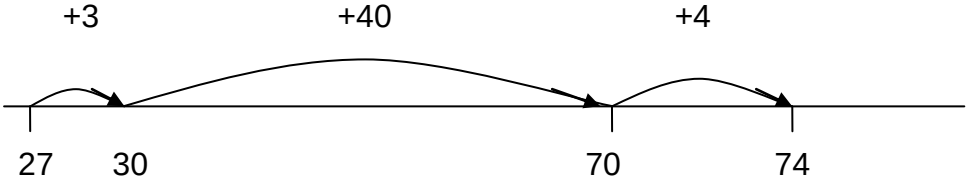
Counting on or counting backwards will both be taught so that children can use the method which they are most comfortable with.

Counting on Method

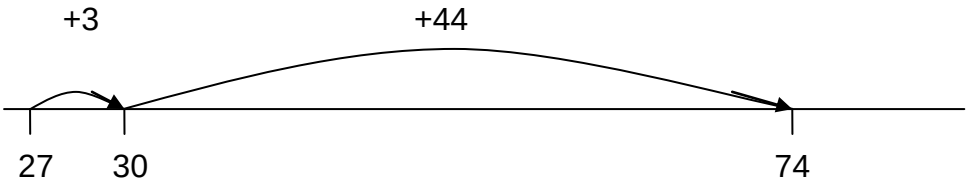
The mental method of counting up from the smaller to the larger number can be recorded using number lines. Children usually find it easiest to make the first jump to the next 10.

The number of jumps will vary. For some children, they will find it comfortable to make only two jumps along the line. Others will need more. Children usually find it easiest to make the first jump to the next 10.

74 - 27 = 47

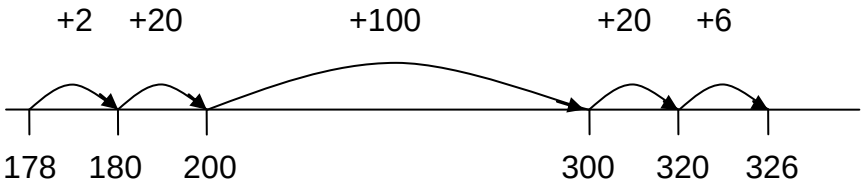


Others will need less jumps, especially when they become confident with the method.

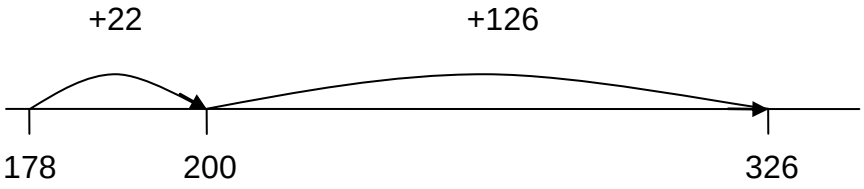


For 3 digit numbers:

326 - 178 = 148



Leading to:



- Children need to be aware that subtraction cannot be done in any order and be able to solve missing number problems.

<u>Expanded layout – formal written method</u>

Partitioning the numbers into tens and units and writing one under the other mirrors the column method, where units are placed under units and tens under tens. The expanded method leads children to the more compact method (on the right hand side of the examples below) so that they understand its structure and efficiency. Children will use a more traditional diagonal line when crossing out numbers.

74 - 27 = 47

70 + 4	$^{60}\cancel{70}$ + $^{1}4$
- 20 + 7	- 20 + 7
———	———
	40 + 7

Column Subtraction – formal written method

74 - 27 = 47

$$\begin{array}{rr} {}^{6}\not{7} & {}^{1}4 \\ - \; 2 & 7 \\ \hline 4 & 7 \end{array}$$

741 - 367 = 374

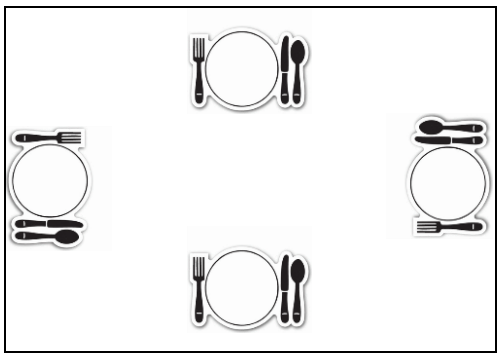
$$\begin{array}{rrr} {}^{6}\not{7} & {}^{13}\not{4} & {}^{1}1 \\ - \; 3 & 6 & 7 \\ \hline 3 & 7 & 4 \end{array}$$

503 - 278 = 225

$$\begin{array}{rrr} {}^{4}\not{5} & {}^{9}\not{0} & {}^{1}3 \\ - \; 2 & 7 & 8 \\ \hline 2 & 2 & 5 \end{array}$$

Transition in stages of multiplication

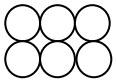
1. **Pictoral multiplication and concrete objects**



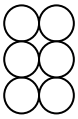
2. **Repeated addition**

3. **Visual arrays**

2 x 3 = 6



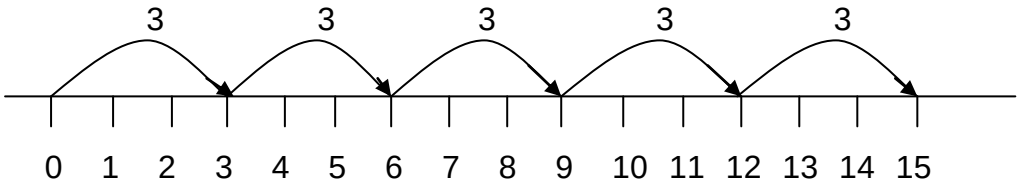
3 x 2 = 6



3 times 5 is 5 + 5 + 5 = 15 or 3 lots of 5 or 5 x 3

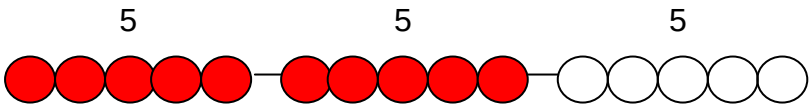
Repeated addition can be shown easily on a number line:

5 x 3 = 3 + 3 + 3 + 3 + 3



And on a bead bar:

5 x 3 = 5 + 5 + 5



- Children need to be aware that multiplication can be done in any order (commutative) and be able to solve missing number problems.

The Grid Method – informal method

Multiplying by a 1 digit number

Teen number x 1 digit number

x	10	7
5	50	35

50
+ 35
= 85

5 x 17 = 85

Any 2 digit number x 1 digit number

x	30	8
7	210	56

210
+ 35
= 266

7 x 38 = 266

Any 3 digit number x 1 digit number

x	100	30	6
7	700	210	42

700
+ 210
42
= 952

7 x 136 = 952

A 2 digit number x teen number

x	10	4
30	300	120
5	50	20

300
120
+ 50
20
= 490

35 x 14 = 490

Any 2 digit number x 2 digit number

x	20	7
50	1000	350
6	120	42

1000
\+ 350
\+ 120
\+ 42
= 1512

56 x 27 = 1512

Three-digit by two-digit

x	200	80	6
20	4000	1600	120
9	1800	720	54

4000
\+ 1800
\+ 1600
\+ 120
\+ 54
= 8294

Expanded short multiplication – formal written method

The next step is to represent the method of recording in a column format, but showing the working. Draw attention to the links with the grid method.

	H	T	U
		3	8
X			7
		5	6
	2	1	0
	2	6	6

Compact short multiplication

The recording is reduced further, with carry digits recorded below the line. If, after practice, children cannot use the compact method without making errors, they should return to the expanded format.

	H	T	U
		3	8
X			7
	2	6	6

Expanded long multiplication

	T	H	T	U
			5	6
X			2	7
			4	2
		3	5	0
		1	2	0
	1	0	0	0
	1	5	1	2

Compact long multiplication

	T	H	T	U
			5	6
X			2	7
		3	9	2
	1	1	2	0
	1	5	1	2

Expanded long multiplication

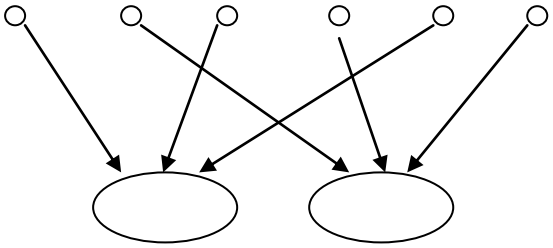
	T	H	T	U
		2	8	6
X			2	9
			5	4
		7	2	0
	1	8	0	0
		1	2	0
	1	6	0	0
	4	0	0	0
	8	2	9	4

Compact long multiplication

	T	H	T	U
		2	8	6
X			2	9
	2	5	7	4
	5	7	2	0
	8	2	9	2

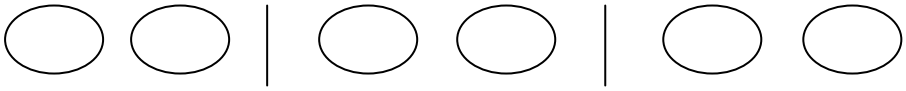
Transition in stages of division – teach no remainders first followed by remainders

1. Practical division



2. Visual arrays/grouping

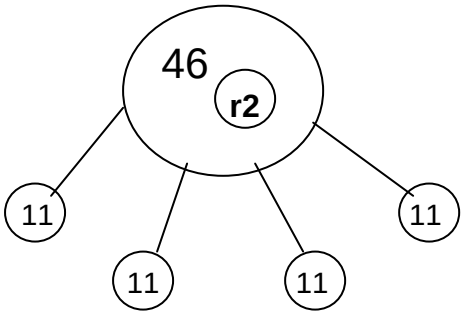
6 divided by 3 – 6 sweets divided between 3 people

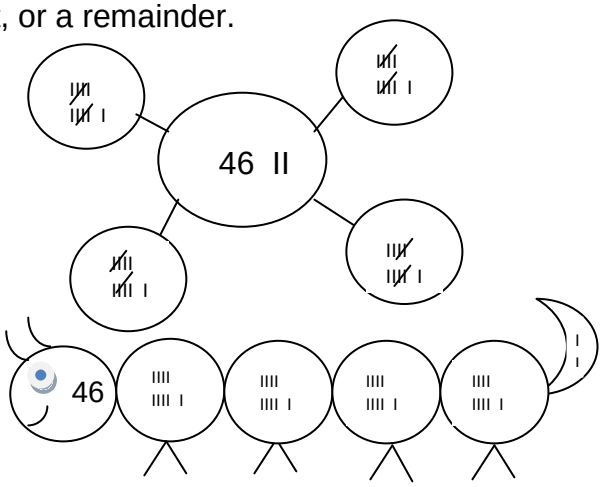


3. The Division 'Spider' or 'Caterpillar'

This method involves a 'spider' or 'caterpillar' with a number of legs/segments which depends on the divisor. The number in the middle of the spider/caterpillar head is gradually reduced until nothing is left, or a remainder.

46 - 4 = 11 r 2

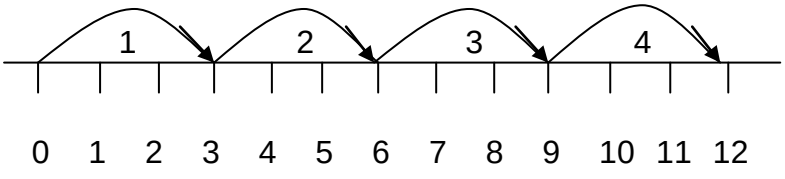




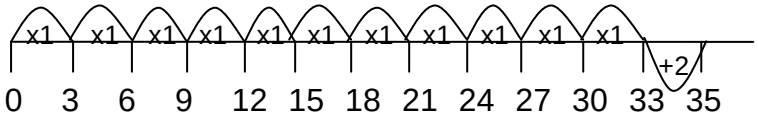
This method is an informal way of recording later methods.

4. Repeated addition

12 ÷ 3 = 4

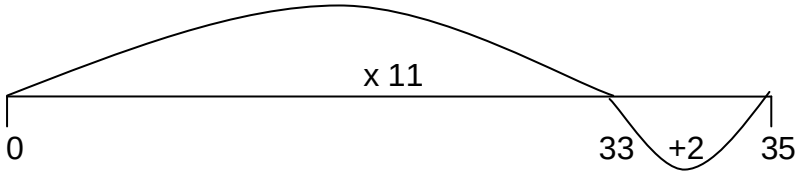


35 ÷ 3 = 11r2



Leading to :

35 ÷ 3 = 11 r2



Children need to be aware that division must be done in the given order and be able to solve missing number questions.

5. Formal written method – short division

Short division of HTU ÷ U can be introduced as an alternative, more compact recording method than chunking, but only when children are secure in the other methods.

$$3\overline{)8^{2}1}\quad 2\ 7$$

6. Formal method of long division for larger number

```
    28  r12
  ------
15 ) 432
   - 300   (15 x 20)
   -----
     130
   - 120    (15 x 8)
   -----
      12
```

Becomes:

```
    28  r12
  ------
15 ) 432
   - 30↓
   -----
     132
   - 120
   -----
      12
```

Date of Next Review : Autumn 2018.