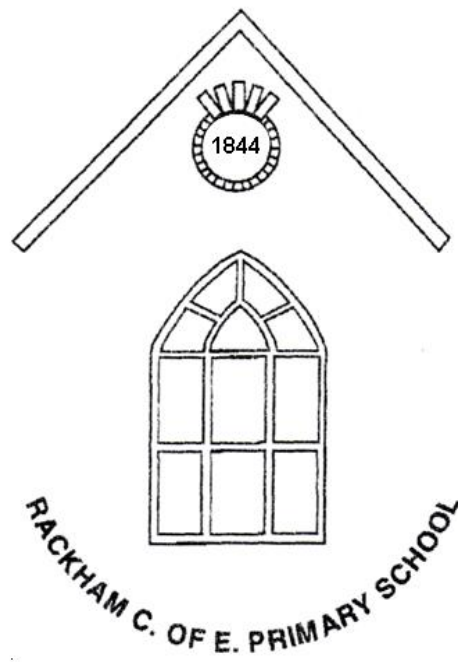


# ***Guidance on Calculation***



***Key Stage 2  
Nov 2016***

## Addition

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

Children will be taught written methods, including vertical addition for those calculations that they cannot do mentally or mentally with jottings. To begin, these will be 'expanded methods' which are ways of recording that make the process of adding the different digits clear to children by partitioning larger numbers into hundreds, tens and units. These expanded methods build on the mental methods they have been learning and should help children to understand what is happening as well as reinforcing their understanding of place value by calling the digits by their value (e.g. two hundred and one hundred rather than two add one).

Here is an example of adding using an expanded method:

$$\begin{array}{r}
 287 \quad \longrightarrow \quad 200 \quad + \quad 80 \quad + \quad 7 \\
 145 \quad \longrightarrow \quad 100 \quad + \quad 40 \quad + \quad 5 \\
 \hline
 432 \quad \longleftarrow \quad 300 \quad + \quad 120 \quad + \quad 12 \\
 \hline
 \end{array}$$

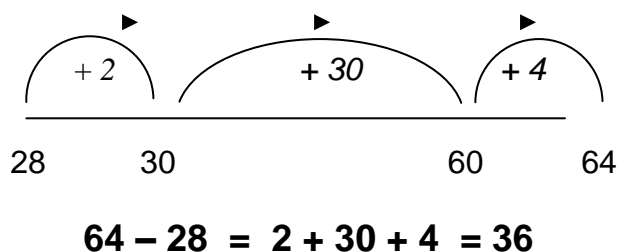
Children will record this as:

$  \begin{array}{r}  287 \\  145 \\  \hline  300 \\  120 \\  12 \\  \hline  432 \\  \hline  \end{array}  $	then	$  \begin{array}{r}  287 \\  145 \\  \hline  12 \\  120 \\  300 \\  \hline  432 \\  \hline  \end{array}  $	<p>leading to the compact method</p> $  \begin{array}{r}  287 \\  145 \\  \hline  432 \\  \hline  \end{array}  $
$200 + 100$ $80 + 40$ $7 + 5$		$7 + 5$ $80 + 40$ $200 + 100$	<p>11</p>

## Subtraction

As with addition, the children will need to be able to carry out simple two digit from two digit subtractions mentally and record their methods before being introduced to vertical written methods.

In Key Stage 2, children will find the difference between two numbers using an empty number line by counting on.



Children should be able to partition numbers into tens and units (e.g.  $64 = 60 + 4$ )

An expanded written method is used to show clearly the processes involved and what happens to the numbers as the calculation progresses:

$$\begin{array}{r} 287 \\ - 135 \\ \hline 152 \end{array} \qquad \begin{array}{r} 200 + 80 + 7 \\ 100 + 30 + 5 \\ \hline 100 + 50 + 2 \end{array}$$

The expanded method makes clear the process of exchanging:

$$\begin{array}{r} 64 \\ - 28 \\ \hline \end{array} \rightarrow \begin{array}{r} 60 + 4 \\ - 20 + 8 \\ \hline \end{array} \text{ becomes } \begin{array}{r} 50 + 14 \\ - 20 + 8 \\ \hline 30 + 6 \end{array}$$

so  $64 - 28 = 36$ .

This is later extended to include exchanges from hundreds to tens and from hundreds to tens and units:

$$\begin{array}{r} 342 \\ - 175 \\ \hline \end{array} \quad \begin{array}{r} 300 + 40 + 2 \\ 100 + 70 + 5 \\ \hline \end{array} \quad \text{becomes} \quad \begin{array}{r} 200 + 140 + 2 \\ 100 + 70 + 5 \\ \hline \end{array}$$

which becomes

$$\begin{array}{r} 200 + 130 + 12 \\ 100 + 70 + 5 \\ \hline 100 + 60 + 7 \end{array} \quad \text{so } 342 - 175 = 167.$$

This may be recorded as:

$$\begin{array}{r} 200 \quad 130 \quad 12 \\ 300 + 40 + 2 \\ 100 + 70 + 5 \\ \hline 100 + 60 + 7 \end{array} \quad \text{so } 342 - 175 = 167.$$

When this is secure, children will be introduced to a more compact method which is also then increased to three and four digit numbers and decimals.

$$\begin{array}{r} \phantom{5} \mathbf{6}^1 \mathbf{4} \\ - \phantom{5} \mathbf{2} \mathbf{8} \\ \hline \phantom{5} \mathbf{3} \mathbf{6} \end{array} \quad \begin{array}{r} \phantom{2} \mathbf{6}^7 \mathbf{1} \\ - \phantom{2} \mathbf{1} \mathbf{5} \mathbf{7} \\ \hline \phantom{2} \mathbf{1} \mathbf{1} \mathbf{4} \end{array}$$


---

## Multiplication

Children should be reasonably comfortable with multiplying single digit numbers by single digit numbers (they might not have instant recall of all multiplication facts but should be able to work out facts reasonably quickly).

Similarly, multiples of 3 double to multiples of 6 and 12; multiples of 10 can be halved to give multiples of 5 times and so on. This uses the knowledge children are developing through addition and subtraction and makes important connections for them.

Children are taught to seek patterns in number sequences and multiplication tables are rich in pattern, e.g. multiples of even numbers will themselves be even, the units digit of multiples of eight repeats the pattern 8, 6, 4, 2, 0, etc.

Children will recognise which method is most appropriate for a given calculation – mental, mental with jottings, calculator, informal or formal written methods.

Partitioning

$$\begin{array}{l} 12 \times 4 \\ = (10 \times 4) + (2 \times 4) \\ = 40 + 8 \\ = 48 \end{array} \qquad \begin{array}{l} 43 \times 5 \\ = (40 \times 5) + (3 \times 5) \\ = 200 + 15 \\ = 215 \end{array}$$

Grid method

$$\begin{array}{r|l|l} 43 \times 5 & \text{x} & 40 & 3 \\ \hline & 5 & 200 & 15 \end{array} = 215 \text{ (added mentally)}$$

The grid method is then extended to multiplying 3 digit numbers by 1 digit numbers and 2 digit numbers by 2 digit numbers:

$$\begin{array}{r|l|l} 34 \times 27 & \text{x} & 30 & 4 \\ \hline & 20 & 600 & 80 \\ & 7 & 210 & 28 \\ \hline & & & 680 \\ & & & 238 \\ & & & \hline & & & 918 \end{array}$$

Children are introduced to a compact method by relating it to the grid layout – same calculation, different layout:

$43 \times 5$

$$\begin{array}{r} 43 \\ \times 5 \\ \hline 15 \quad (5 \times 3) \\ \underline{200} \quad (5 \times 40) \\ 215 \end{array}$$

↓

$$\begin{array}{r} 43 \\ \times 5 \\ \hline 215 \\ 1 \end{array}$$

$34 \times 27$

$$\begin{array}{r} 34 \\ \times 27 \\ \hline 28 \quad (7 \times 4) \\ 210 \quad (7 \times 30) \\ 80 \quad (20 \times 4) \\ \underline{200} \quad (20 \times 30) \\ 918 \end{array}$$

↓

$$\begin{array}{r} 34 \\ \times 27 \\ \hline 238 \quad (7 \times 34) \\ \underline{680} \quad (20 \times 34) \\ 918 \end{array}$$

Those children who are confident and competent multiplying larger numbers using an expanded method will be introduced to a compact multiplication method.

$$\begin{array}{r} 43 \\ \times 15 \\ \hline 215 \end{array}$$

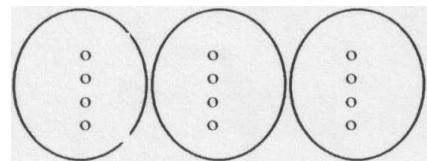
$$\begin{array}{r} 43 \\ \times 15 \\ \hline 215 \\ \underline{430} \\ 645 \end{array}$$

---

## Division

Before undertaking written division, children should be able to divide numbers by 10 and 100 mentally, understanding how the digits move. They should be able to halve numbers and be beginning to understand relationship between  $\times$  and  $\div$ , i.e. that they are inverse operations and that division facts can be derived from multiplication ones.

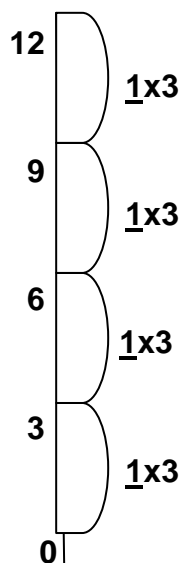
They will have experience of sharing, e.g.  $12 \div$



and of grouping, rephrasing  $12 \div 3$  as 'how many 3s make 12?', then counting up in multiples of 3 to 12.

Children will use vertical number lines and count up in groups of numbers.

**$12 \div 3$**



**$4 \times 3 = 12$**

The children start with simple calculations linked to their mental work and as the size of the numbers increases, the chunking written method is more efficient than counting up.

e.g. **73 ÷ 5** *How many 5s in 73?*

$$\begin{array}{r}
 73 \\
 - \underline{50} \quad 10 \times 5 \\
 23 \\
 - \underline{20} \quad 4 \times 5 \\
 3
 \end{array}$$

Children are encouraged to think about 'chunks' they know first - giving a bank of known facts to work from, e.g.  $10 \times 5 = 50$ . This enables children to remove larger chunks so  $20 \times 5 = 100$  etc.

Once children have mastered this, division notation is introduced but the process is retained. Extension to 3 digit numbers follows:

**256 ÷ 7**

$$\begin{array}{r}
 7 \overline{) 256} \\
 - 70 \quad 10 \times 7 \\
 \hline
 186 \\
 - 70 \quad 10 \times 7 \\
 \hline
 116 \\
 - 70 \quad 10 \times 7 \\
 \hline
 46 \\
 - 42 \quad 6 \times 7 \\
 \hline
 4
 \end{array}$$

Answer **36 r4**

This is compacted by removing larger chunks

**256 ÷ 7**

$$\begin{array}{r}
 7 \overline{) 256} \\
 - 210 \quad 30 \times 7 \\
 \hline
 46 \\
 - 42 \quad 6 \times 7 \\
 \hline
 4
 \end{array}$$

Answer **36 r4**



Those children who are confident and competent dividing using an expanded method will be introduced to a compact/short division method.

$$256 \div 7$$

$$7 \overline{) 256} \begin{array}{r} 36r4 \\ 254 \\ \hline 6 \end{array}$$

### Calculating with Fractions

#### Y3 and 4

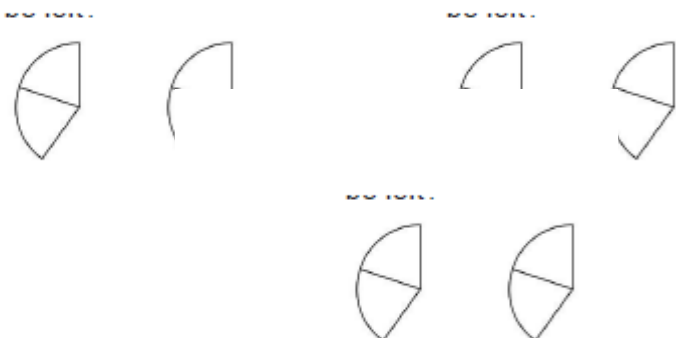
- add and subtract fractions with the same denominator within one whole.

Eg  $1/3 + 1/3 = 2/3$

#### Y5

- Add and subtract fractions with the same denominator and denominators that are multiples of the same number.

$3/4 - 2/4 = 1/4$



rs by whole numbers,

## Y6

- Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions.

$$1/4 + 1/2 = 3/4$$

$$12/15 - 3/5 = 6/15$$

- Multiply simple pairs of proper fractions, writing the answer in its simplest form

$$1/4 \times 1/2 = 1/8$$

- Divide proper fractions by whole

**Step 1.** The bottom numbers (the **denominators**) are already the same. Go straight to step 2.

**Step 2.** Add the top numbers and **put the answer over the same denominator:**

$$\frac{1}{4} + \frac{1}{4} = \frac{1 + 1}{4} = \frac{2}{4}$$