Southwick CE Primary School

CALCULATION POLICY

Southwick Primary School is committed to an 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 approximate their answers before calculating.
- Children should be encouraged to check their answers after calculation using an appropriate strategy.
- Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.

Addition

Reception Year

- Calculations involve real objects. Children combine two sets of objects to make a total. Recording (sketches and, later, simple number sentences) is modelled by teacher.

Year 1

- Learners use practical apparatus (cubes, counters bead strings, fingers) to add numbers, and a 'number sentence' is recorded:

  $8 + 1 = 9$

- Number lines are provided for 'counting on' by hopping up one step at a time (pointing with finger)
- Children's own jottings are actively encouraged:

  $5 + 3 = 8$

- Pupils are taught to put the larger number 'in their head' and count on using fingers (e.g. 3 + 6: start from the 6 and count on 3)

- Boxes represent missing digits in number sentences:

$2 + \square = 6$

"If I start at 2
I count on 4
more to reach 6"

Year 2

- Children begin to draw and label their own number lines
- 'Formal' recording is horizontal:

$22 + 5 = 27$

- Children begin to partition (split up) numbers where it's helpful:

$48 + 7$

$48 + 2 + 5$

"I'll add 2 to get to 50. There's 5 more to add after that, so the total is 55."

$50 + 5$

55

- Boxes represent missing digits or missing signs in number sentences:

$\square + 12 = 20$

$27 \ \square \ 8 = 35$

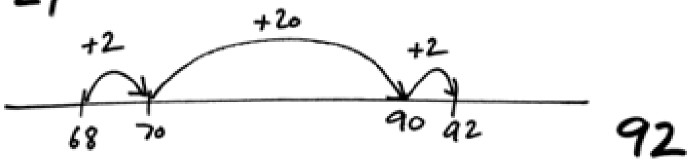
Year 3

- Pupils practise partitioning numbers in different ways:

$346 = 300 + 46$
$300 + 40 + 6$
$300 + 30 + 16$
$200 + 120 + 26 \ldots$

- Learners draw their own empty number lines (lines without all the digits marked in); they 'bridge' through multiples of 10:

$68 + 24$



"I'll count on 2 to reach 70. Then I can jump 20 to reach 90. I need to add just 2 more after that. The answer is 92."

- Children begin to record formally using a vertical format and partitioning (splitting numbers up) (see Year 4, below).

Year 4

- 2- and 3-digit numbers are decomposed (broken into parts):

$$\begin{array}{rcl} 367 & = & 300 + 60 + 7 \\ +\ 185 & = & \underline{100 + 80 + 5} \\ & & 400 + 140 + 12 \quad = 552 \end{array}$$

Some children may need additional steps, e.g.:

$$\begin{array}{l} 400 + 140 + 12 \\ 500 + 40 + 12 \\ 500 + 50 + 2 \\ 552 \end{array}$$

- Partitioning is recorded vertically:

$$\begin{array}{rl} 367 & \\ +\ \underline{185} & \\ 400 & (300+100) \\ 140 & (60+80) \\ \underline{12} & (7+5) \\ \underline{552} & \end{array}$$

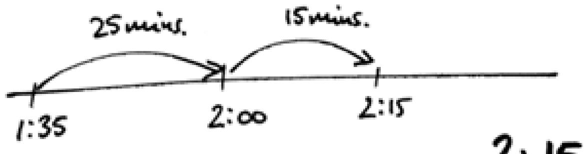
“In my head I usually start with the hundreds so I'll do that here. I take each column one at a time and write down what the total is. I'm careful to keep the columns lined up accurately or I'll get very muddled!”

The 'in-between steps' are used for as long as they are helpful:

$$\begin{array}{r} 367 \\ +\ \underline{185} \\ 12 \\ 140 \\ \underline{400} \\ \underline{552} \end{array}$$

“Starting with the units will help when I use traditional recording. I'm confident that I won't muddle things so I won't label the separate totals any more.”

- Problems are still solved using a number line (e.g. 'A cake went in the oven at 1:35. It cooked for 40 minutes. What time did it come out?')



2:15

“I'll split the extra 40 minutes into 2 bits: 25 minutes to get to the next o'clock and then 15 minutes more to reach 2:15.”

Year 5

- Partitioning and decomposition is now recorded in the traditional vertical format w... ds etc. 'carried' forwards and noted below the answer:

$$\begin{array}{r} 367 \\ +\ 185 \\ \hline 552 \\ \hline {\scriptstyle 1\ 1\ } \end{array}$$

The 'carried' number is referred to as 'one ten', 'one hundred' etc. not just 'one'.

Year 6

- Children use a secure, reliable method of written calculation, where this is appropriate
- They still use quick mental methods in preference where these are feasible
- Existing methods are extended to larger values and modified slightly to handle decimal numbers (ensure columns are lined up either side of the decimal point)
- When adding decimal values pupils estimate answers by rounding:

$57.3 + 76.9$ $\qquad$ $60 + 80$

“I'll round these numbers roughly. The answer must be close to 60 + 80, so that's about 140. If the decimal parts confuse me and I get a completely different answer I'll try again...”

Subtraction

Reception Year

- Calculations mostly use real objects. Simple recording using sketches and written numerals is modelled by the teacher.

Year 1

- Practical apparatus is used (counters, cubes, coins) and a 'number sentence' is recorded:

$8 - 5 = 3$

- Objects are sketched and then crossed out to represent 'taking away' (objects are often grouped in 5's to help children visualise numbers more clearly):

$9 - 6 = 3$

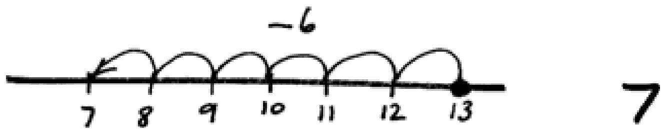
- Number lines are provided to support 'counting back' by hopping down one step at a time (pointing with finger).

Year 2

- Children begin to draw their own number lines:

$13-6$

"I start on 13. One hop takes me to 12. Another hop and another... ...six hops takes me back to 7."

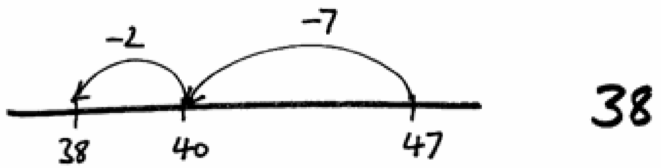


Year 3

- Children draw their own empty number lines (lines without all the digits marked in)
- They 'bridge' through 10's:

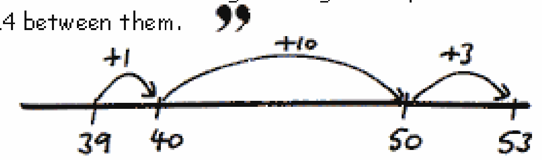
$47-9$

"Taking 7 from 47 is easy: I land on 40. I know that 7 + 2 is 9 so I've got another 2 still to take away. That takes me to 38."



- A 'difference' can be calculated by adding on:

"The difference between 53 and 39? I'll count up from the smaller to the bigger number. I can bridge through multiples of 10. Altogether there's 14 between them."



$53-39=14$

- Numbers are 'partitioned' (split up):

$112-30$

$100+12-30$

$100-30=70$

$70+12=82$

$112-30=82$

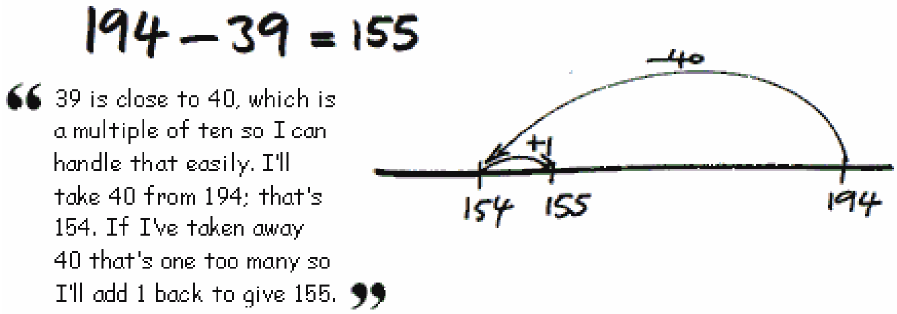
"This is a bit tricky as I'll cross the 100 boundary. I'll partition 112 to make 100 plus 12. Now I can subtract 30 from 100 (that makes 70) and put back the 12 to make 82."

This recording represents a series of mental steps. Each step stands alone and is recorded on its own line. The steps are not connected with the = sign (because they're not equal).

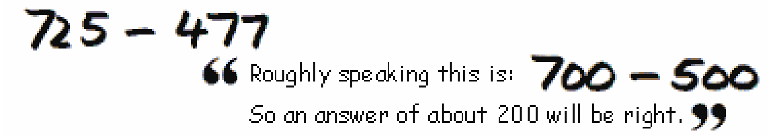
- 'Formal' recording is still horizontal (as a 'number sentence' - see Year 1, above).

Year 4

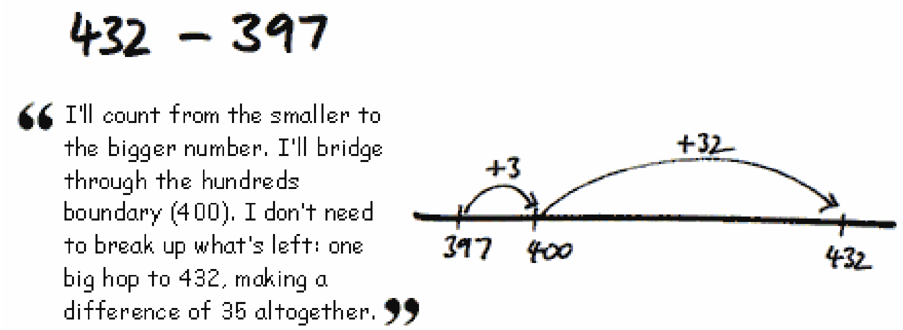
- 'Adjusting' is used where helpful, and is recorded on an empty number line (one without every number marked in):



- 2- and 3-digit numbers are rounded to estimate answers:



- 'Counting up' is extended to larger values, always bridging through hundreds and tens boundaries where helpful:



- Tens-and-Units numbers or Hundreds-Tens-and-Units numbers are 'decomposed' (broken into component parts):

$124 - 79$

$$\begin{array}{r} 100 + 20 + 4 \\ -\quad 70 + 9 \end{array}$$

❝124 is 100 + 20 +4.
I need to subtract 70 and 9.
I can't subtract 9 from 4 in the units column so…

$$\begin{array}{r} 100 + 10 + 14 \\ -\quad 70 + 9 \end{array}$$

…I'll exchange 1 ten from the next column to make 14.
I can't subtract 70 from 10 in the tens column so…

$$\begin{array}{r} 110 + 14 \\ -\quad 70 + 9 \\ \hline 40 + 5 \end{array}$$

…I'll take the 100 from the next column to make 110.

Now I can complete the calculatation.❞

- This approach is long-winded (in the example above it would have been more efficient to subtract 80 and adjust by adding 1) but it sets the scene for the formal written method:
- The formal written method for subtraction (see below) is introduced.

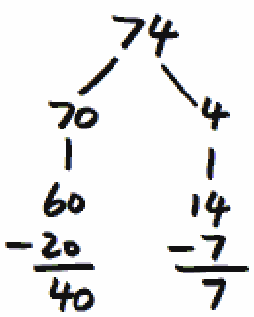
Year 5

- Vertical recording, illustrating decomposition (breaking into component parts) in alternative ways:

$74 - 27$

$$\begin{array}{r} \overset{60}{\cancel{70}} + \overset{14}{\cancel{4}} \\ -\ 20 + 7 \\ \hline 40 + 7 \end{array}$$

or



As learners rely less and less on the 'in-between steps' this quickly becomes the familiar formal written method. Children speak of 'exchanging' from higher columns (the potentially confusing notion of 'borrowing' is not used):

$$\begin{array}{r} {}^{6}\cancel{7}{}^{1}4 \\ -27 \\ \hline 47 \end{array}$$

Year 6

- The continued need to use jottings to support mental methods of subtraction is emphasised where helpful
- Existing methods are extended to larger values and modified slightly to handle decimal numbers (ensure columns are lined up either side of the decimal point)
- Estimation, to check the size of answers, remains crucial (especially when using a calculator)
- No wholly new methods of subtraction are employed.

Multiplication

Reception Year

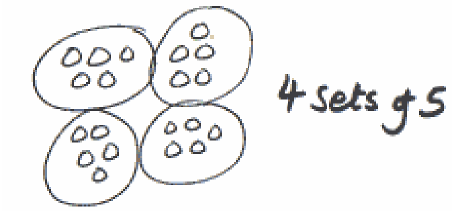
- Calculations almost always involve real objects. Children make several sets of objects, sometimes of equal size.

Year 1

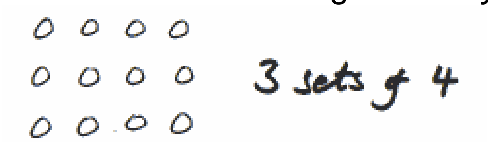
- Learners use cubes (or other counters and coins) to make doubles (and near-doubles).

Year 2

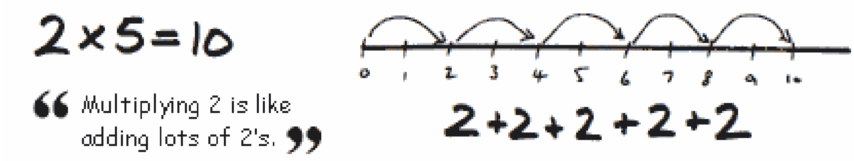
- Children use knowledge of doubles (and near doubles) to carry out calculations in 'real-life' situations (e.g. shopping)
- Objects are grouped in 2's, 5's and 10's:



- Learners draw rectangular arrays (to help show what multiplying means):



- Children use the multiplication symbol when recording simple multiplication calculations; these are recorded as jumps on a number line (and understood as repeated addition):

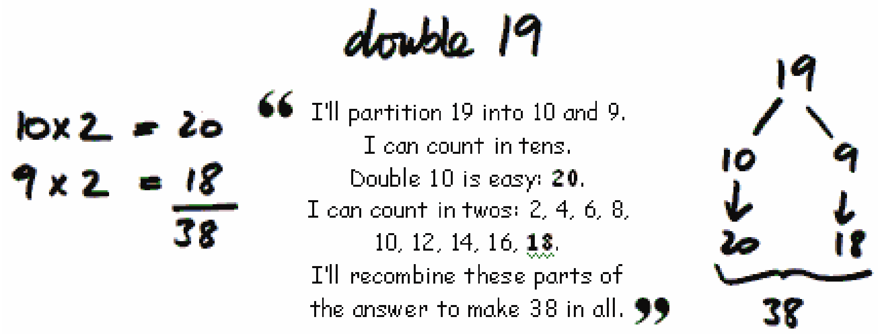


- Children use the idea of multiplication when using coins:

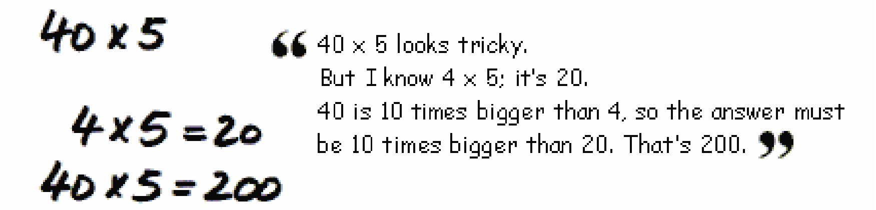
- Children start to learn times table facts (x10, x2, x5).

Year 3

- Year 2 concepts are reinforced. Learning times tables becomes crucial: a good order after the 10's, 2's and 5's is x3, 4, 9, 6, 7, 8
- Larger values can be multiplied by partitioning and recombining (2 alternative jottings are shown):

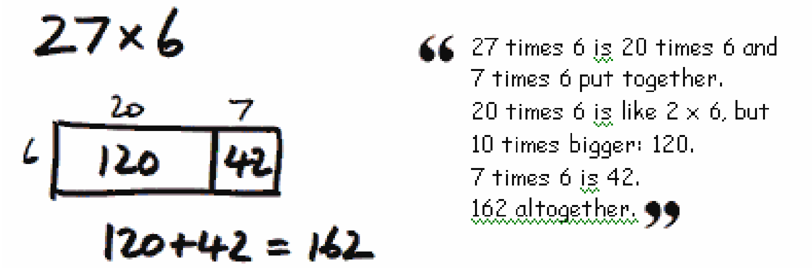


- An understanding of place value makes harder calculations possible:



Year 4

- Learners start to use the grid method (this illustrates the partition of larger values, and makes clear the separate parts of the calculation):



- Knowledge of multiplication facts ('times tables') is increasingly important. Children need to know the connection between tables facts and division facts too.

Year 5

- Numbers are rounded so that estimates can be made (this is especially important

24 x 16 20 x 15 = 300

"I estimate the answer to be *something* like 300."

- The grid method is extended to larger numbers:

"The grid reminds me that there are **four** parts to this calculation. I use the times-table facts that I know and my knowledge of place value to find each part before adding them together to get the complete answer."

	20	4
10	200	40
6	120	24
	320	64

$\rightarrow$ 384

Year 6

- When the grid method is understood then the familiar formal written method can be seen as a shorthand way of recording and combining all the parts of a multiplication (these shortcut recordings are introduced in Year 5 if appropriate):

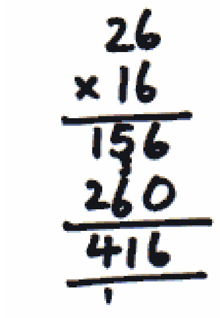
```
  26
x 16
----
 200  (20 x 10)
 120  (20 x 6)
  60  (6 x 10)
  36  (6 x 6)
----
 416
----
```

This is an expanded version of the formal method. Writing the partial products down the side is a good way to keep tabs on what's going on, especially while children build their confidence.

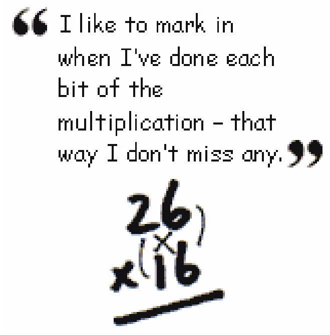
- The layout below is a bit more abbreviated than the previous recording (above). It's very important that all four partial products (6 x 6; 6 x 20; 10 x 6; 10 x 20) are calculated.

```
  26
x 16
----
 156  (26 x 6)
  3
 260  (26 x 10)
----
 416
 1
```

- Below is the shorthand version.



Is this better than the grid method? Only if it's at least as accurate and at least as fast. If your child handles the grid method well then that's fine too.



Division

Reception Year

- Division is based on the concept of sharing. Reception age learners are encouraged to share in all sorts of situations.

Year 1

- Children learn about halving: 'What is half of these 6 eggs?', 'How much is half of 10p?'
- They use practical apparatus and coins and record in pictures: 'How many pairs will these 12 socks make?', 'Share these 15 pencils equally between 5 pots.'

Year 2

- Learners continue to use practical apparatus and coins, plus pictures to record: 'Place 14 dots equally on both sides of this ladybird':

"There are seven dots on each side so half of 14 is 7."

'How could you share 20p between 4 people?':

"5p + 5p + 5p + 5p is 20p..."

"...so 20p divided by 4 is 5p."

- Solve simple division problems by repeated subtraction using counters:

$12-2-2-2-2-2-2=0$

"I was able to take away 6 lots of 2, so..."

$12 \div 2 = 6$

- Learners record repeated jumps backwards on a number line:

$12 \div 2$

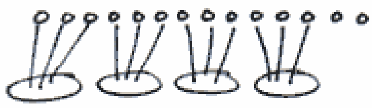
"6 hops of 2 from 12 back to 0, so the answer is 6."

Year 3

- Children begin to recognise that finding fractions of quantities involves division:

"$\frac{1}{4}$ of 20p is 20p ÷ 4"

- Learners use counters and number lines to solve division problems (perhaps involving a remainder): 'How many teams of 3 can be made with 14 people?'



"4 groups of 3 with 2 left over, so the answer is 4 full teams."

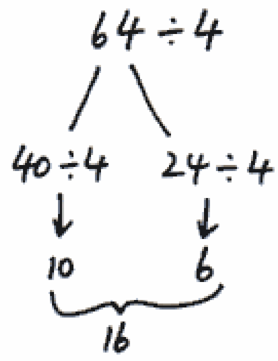
- The link between multiplication and division facts is made and emphasised: 'For every known multiplication ('times table') fact there are three 'free gifts'':

"I know that: $7 \times 6 = 42$ ...so I also know that: $6 \times 7 = 42$, $42 \div 6 = 7$, $42 \div 7 = 6$ No problem!"

Year 4

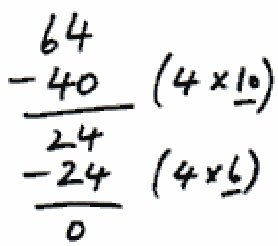
- ( ) numbers to divide:

  “I can partition the big number into 2 smaller ones that I can handle… ”



  (The style of recording this is not important: it's the ability to use known facts skillfully that is being encouraged.)
- The idea of 'chunking' is introduced: rather than hop backwards one step each time it is more efficient to jump back in larger, known, 'chunks':

  “I'll not subtract 4 at a time… I know 10 lots of 4 is 40… When I take that away I'm left with 24… I recognise 24! It's 6 lots of 4… take that away and there's nothing left… So the answer is 16 lots of 4 and no remainder. ”

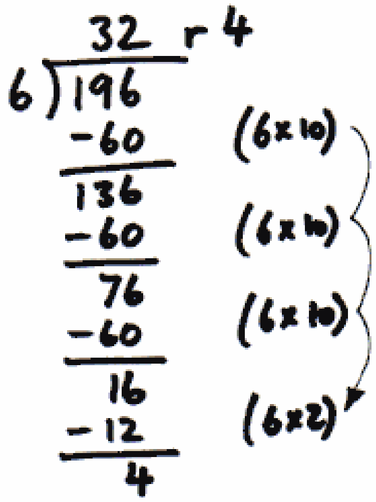


- The relationship between multiplication and division facts ('times tables') continues to be emphasised.

Year 5

- Learners extend the use of chunking and record vertically. They take away multiples of what they're dividing by (chunks). These successive subtractions are recorded in columns. It's important to line things up accurately: units under units, tens under tens:

  “Subtracting 6 at a time will take ages: I'll take off ten 6's, I know that's 60.”



  “I took away 10 sixes, 10 sixes, 10 sixes again, then 2 sixes: that's 32 sixes in total. There were 4 left over, which is the remainder. Answer? 32 remainder 4, which I write at the top. ”

- Children are taught to estimate the answer beforehand to check if a calculated answer is likely:

> “196 divided by 6?
> Because I know 6 x 3 is 18 I can see that 6 x 30 =180.
> 180 is not far off 196 so I expect an answer that's a bit bigger than 30.”

- Secure understanding of place value and recognition of patterns extends learners' knowledge effectively:

$$\begin{array}{ll} 32 \div 8 = 4 & \\ 320 \div 80 = 4 & 320 \div 8 = 40 \\ 3200 \div 800 = 4 & 3200 \div 80 = 40 \end{array}$$

Year 6

- With good 'times table' knowledge and an understanding of place value children can take away bigger chunks:

> “6 x 3 is 18, so 6 x 30 is 180… I'll take that off in one go…

$$\begin{array}{rl} & 32\ r\,4 \\ 6\,\big) & 196 \\ & -180\ \ (6 \times 30) \\ & 16 \\ & -12\ \ (6 \times 2) \\ & 4 \end{array}$$

> 30 sixes and 2 sixes with 4 left over: the answer is 32 r 4.”

- An abbreviated method is used in upper Key Stage 2 (Y5 and Y6) (this is likely to be more familiar to parents). This method 'forgets' about the value of the digits. You 'work along' the starting number a column at a time. Everything must line up accurately, or an error is almost inevitable:

$$\begin{array}{rl} & 32\ r\,4 \\ 6\,\big) & 196 \\ & \underline{18}\downarrow \\ & 16 \\ & \underline{12} \\ & 4 \end{array}$$

This can be abbreviated even further:

$$\begin{array}{rl} & 32\ r\,4 \\ 6\,\big) & 1{}^{1}9{}^{1}6 \end{array}$$

With this method calculations with bigger numbers and decimal numbers are not much more difficult.

- The need to estimate answers is emphasised. This is especially important when doing calculations using decimal values:

> “25.6 divided by 8?
> The closest multiple of 8 near to 25.6 is 24. This is 8 × 3 so an answer of 3 point something is what I expect.”