Hill View Primary Academy Calculation Policy – **YEAR 6**

KEY STAGE 2		
In upper Key Stage 2, children build on secure foundations in calculation, and develop fluency, accuracy and flexibility in their approach to the four operations. They work with whole numbers and adapt their skills to work with decimals, and they continue to develop their ability to select appropriate, accurate and efficient operations.		
Key language: decimal, column methods, exchange, partition, mental method, ten thousand, hundred thousand, million, factor, multiple, prime number, square number, cube number		
Addition and subtraction: Children build on their column methods to add and subtract numbers with up to seven digits, and they adapt the methods to calculate efficiently and effectively with decimals, ensuring understanding of place value at every stage. Children compare and contrast methods, and they select mental methods or jottings where appropriate and where these are more likely to be efficient or accurate when compared with formal column methods. Bar models are used to represent the calculations required to solve problems and may indicate where efficient methods can be chosen.	**Multiplication and division:** Building on their understanding, children develop methods to multiply up to 4-digit numbers by single-digit and 2-digit numbers. Children develop column methods with an understanding of place value, and they continue to use the key skill of unitising to multiply and divide by 10, 100 and 1,000. Written division methods are introduced and adapted for division by single-digit and 2-digit numbers and are understood alongside the area model and place value. In Year 6, children develop a secure understanding of how division is related to fractions. Multiplication and division of decimals are also introduced and refined in Year 6.	**Fractions:** Children find fractions of amounts, multiply a fraction by a whole number and by another fraction, divide a fraction by a whole number, and add and subtract fractions with different denominators. Children become more confident working with improper fractions and mixed numbers and can calculate with them. Understanding of decimals with up to 3 decimal places is built through place value and as fractions, and children calculate with decimals in the context of measure as well as in pure arithmetic. Children develop an understanding of percentages in relation to hundredths, and they understand how to work with common percentages: 50%, 25%, 10% and 1%.

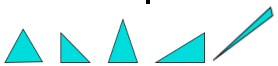
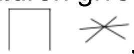
The following pages show the *Power Maths/HVPA* progression in calculation (addition, subtraction, multiplication and division) and how this works in line with the National Curriculum. The consistent use of the CPA (concrete, pictorial, abstract) approach across our curriculum helps children develop mastery across all the operations in an efficient and reliable way. This policy shows how these methods develop children's confidence in their understanding of both written and mental methods.

The **CONCRETE** stage introduces real objects that children can use to 'do' the maths − any familiar object that a child can manipulate and move to help bring the maths to life. It is important to appreciate, however, that children must always understand the link between models and the objects they represent. Although they can be used at any time, good concrete models are an essential first step in understanding.

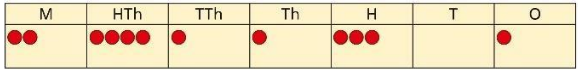
PICTORIAL representations of objects to let children 'see' what particular maths problems look like. It helps them make connections between the concrete and pictorial representations and the abstract maths concept. Children can also create or view a pictorial representation together, enabling discussion and comparisons.

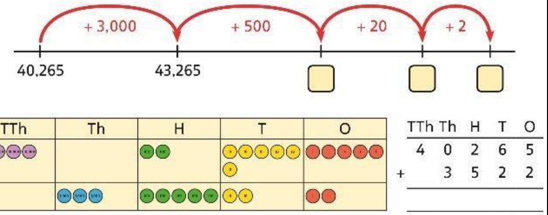
Our ultimate goal is for children to understand **ABSTRACT** mathematical concepts, signs and notation and, of course, some children will reach this stage far more quickly than others. To work with abstract concepts, a child needs to be comfortable with the meaning of, and relationships between, concrete, pictorial and abstract models and representations. The C-P-A approach is not linear, and children may need different types of models at different times. However, when a child demonstrates with concrete models and pictorial representations that they have grasped a concept, we can be confident that they are ready to explore or model it with abstract signs such as numbers and notation.

What are Non-examples?

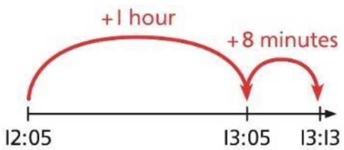
Even with  as examples, a learner does not have enough information to know what is not a triangle. Selected non-examples, like, , help focus attention on details that might otherwise be missed. The "three sides" must be straight, not curved; there can be no extra frills or bows or hanging-over bits of line (line segments must intersect only at their endpoints); the "points" can't be "cut off" (the shape is bounded by only three segments); the figure must be closed (all endpoints must be joined).
These non-examples were selected to be "near-misses," very close to the image people have of triangles. When children give verbal descriptions of triangles, they often mention "three lines" or "three corners," but omit the details that eliminate even fairly distant misses, like, , which may sometimes be useful non-examples to help children improve their verbal descriptions.

<table>
<tr><th colspan="4">Year 6</th></tr>
<tr><th>Year 6 Addition</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Comparing and selecting efficient methods</td>
<td>Represent 7-digit numbers on a place value grid, and use this to support thinking and mental methods.


</td>
<td>Discuss similarities and differences between methods, and choose efficient methods based on the specific calculation.
Compare written and mental methods alongside place value representations.



Use bar model and number line representations to model addition in problem-solving and measure contexts.


</td>
<td>Use column addition where mental methods are not efficient. Recognise common errors with column addition.

32,145 + 4,302 = ?

<table>
<tr><th></th><th>TTh</th><th>Th</th><th>H</th><th>T</th><th>O</th></tr>
<tr><td></td><td>3</td><td>2</td><td>1</td><td>4</td><td>5</td></tr>
<tr><td>+</td><td></td><td>4</td><td>3</td><td>0</td><td>2</td></tr>
<tr><td></td><td>3</td><td>6</td><td>4</td><td>4</td><td>7</td></tr>
</table>

<table>
<tr><th></th><th>TTh</th><th>Th</th><th>H</th><th>T</th><th>O</th></tr>
<tr><td></td><td>3</td><td>2</td><td>1</td><td>4</td><td>5</td></tr>
<tr><td>+</td><td>4</td><td>3</td><td>0</td><td>2</td><td></td></tr>
<tr><td></td><td>7</td><td>5</td><td>1</td><td>6</td><td>5</td></tr>
</table>

Which method has been completed accurately?

What mistake has been made?

Column methods are also used for decimal additions where mental methods are not efficient.

<table>
<tr><th></th><th>H</th><th>T</th><th>O</th><th>·</th><th>Tth</th><th>Hth</th></tr>
<tr><td></td><td>1</td><td>4</td><td>0</td><td>·</td><td>0</td><td>9</td></tr>
<tr><td>+</td><td></td><td>4</td><td>9</td><td>·</td><td>8</td><td>9</td></tr>
<tr><td></td><td>1</td><td>8</td><td>9</td><td>·</td><td>9</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td></tr>
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</td>
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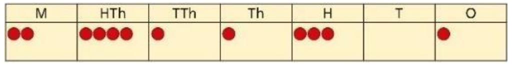
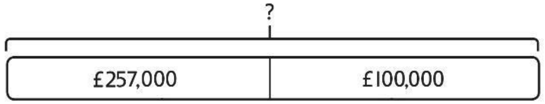
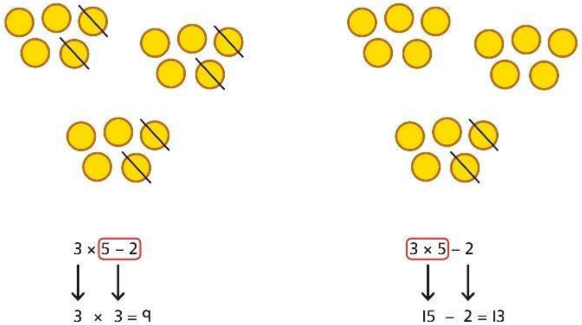
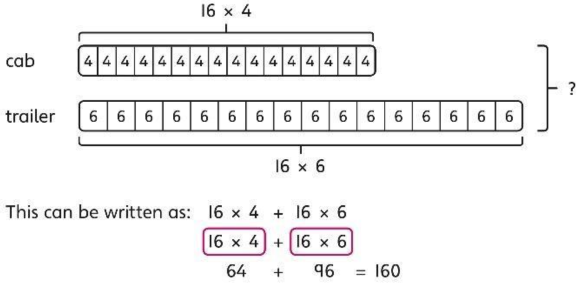
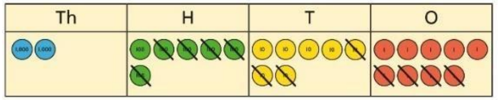
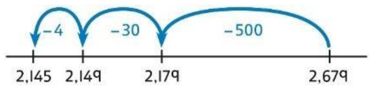
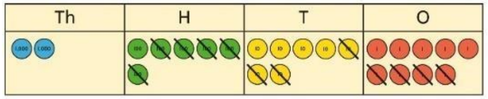
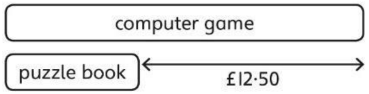
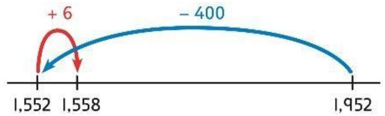
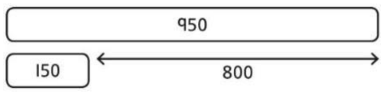
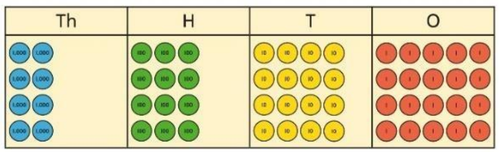
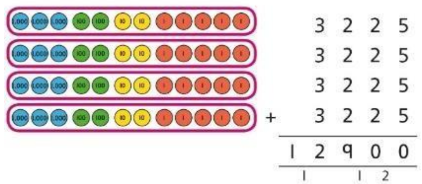
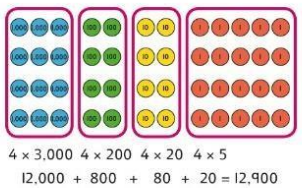
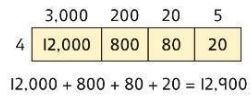
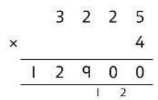
Selecting mental methods for larger numbers where appropriate	Represent 7-digit numbers on a place value grid, and use this to support thinking and mental methods.  *2,411,301 + 500,000 = ?* *This would be 5 more counters in the HTh place.* *So, the total is 2,911,301.* *2,411,301 + 500,000 = 2,911,301*	Use a bar model to support thinking in addition problems. *257,000 + 99,000 = ?*  *I added 100 thousands then subtracted 1 thousand.* *257 thousands + 100 thousands = 357 thousands* *257,000 + 100,000 = 357,000* *357,000 – 1,000 = 356,000* *So, 257,000 + 99,000 = 356,000*	Use place value and unitising to support mental calculations with larger numbers. *195,000 + 6,000 = ?* *195 + 5 + 1 = 201* *195 thousands + 6 thousands = 201 thousands* *So, 195,000 + 6,000 = 201,000*
Understanding order of operations in calculations	Use equipment to model different interpretations of a calculation with more than one operation. Explore different results. *3 × 5 − 2 = ?* 	Model calculations using a bar model to demonstrate the correct order of operations in multi-step calculations. 	Understand the correct order of operations in calculations without brackets. Understand how brackets affect the order of operations in a calculation. *4 + 6 × 16* *4 + 96 = 100* *(4 + 6) × 16* *10 × 16 = 160*

<table>
<tr><th>Year 6 Subtraction</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Comparing and selecting efficient methods</td>
<td>Use counters on a place value grid to represent subtractions of larger numbers.
</td>
<td>Compare subtraction methods alongside place value representations.


$$\begin{array}{cccc} Th & H & T & O \\ \hline 2 & 6 & 7 & 9 \\ - & 5 & 3 & 4 \\ \hline 2 & 1 & 4 & 5 \\ \hline \end{array}$$
Use a bar model to represent calculations, including ‘find the difference’ with two bars as comparison.
</td>
<td>Compare and select methods. Use column subtraction when mental methods are not efficient.
Use two different methods for one calculation as a checking strategy.
$$\begin{array}{ccccc} & Th & H & T & O \\ \hline & 1 & {}^{8}\cancel{9} & {}^{14}\cancel{5} & {}^{1}2 \\ - & 1 & 5 & 5 & 8 \\ \hline & & 3 & 9 & 4 \\ \hline \end{array}$$

Use column subtraction for decimal problems, including in the context of measure.
$$\begin{array}{cccccc} & H & T & O & \cdot\ Tth & Hth \\ \hline & 3 & 0 & 9 & \cdot\ 6 & 0 \\ - & 2 & 0 & 6 & \cdot\ 4 & 0 \\ \hline & 1 & 0 & 3 & \cdot\ 2 & 0 \\ \hline \end{array}$$</td>
</tr>
</table>

Subtracting mentally with larger numbers		Use a bar model to show how unitising can support mental calculations. *950,000 − 150,000* *That is 950 thousands − 150 thousands*  *So, the difference is 800 thousands. 950,000 − 150,000 = 800,000*	Subtract efficiently from powers of 10. *10,000 − 500 = ?*

Year 6 Multiplication	**Concrete**	**Pictorial**	**Abstract**
Multiplying up to a 4-digit number by a single digit number	Use equipment to explore multiplications.  *4 groups of 2,345* *This is a multiplication:* *4 × 2,345* *2,345 × 4*	Use place value equipment to compare methods. **Method 1**  **Method 2** 	Understand area model and short multiplication. Compare and select appropriate methods for specific multiplications. **Method 3**  **Method 4** 

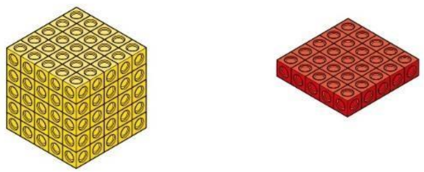
<table>
<tr>
<td>Multiplying up to a 4-digit number by a 2-digit number</td>
<td></td>
<td>Use an area model alongside written multiplication.

Method 1
<table>
<tr><td></td><td>1,000</td><td>200</td><td>30</td><td>5</td></tr>
<tr><td>20</td><td>20,000</td><td>4,000</td><td>600</td><td>100</td></tr>
<tr><td>1</td><td>1,000</td><td>200</td><td>30</td><td>5</td></tr>
</table>

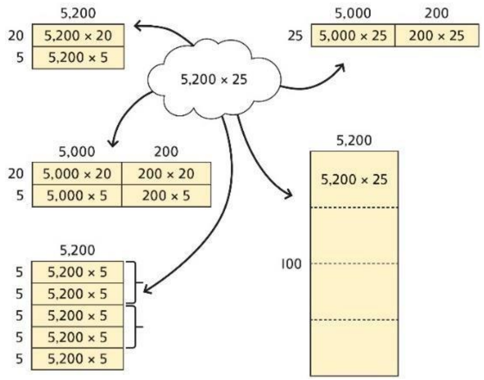
1 2 3 5
× 2 1
5   1 × 5
3 0   1 × 30
2 0 0   1 × 200
1 0 0 0   1 × 1,000
1 0 0   20 × 5
6 0 0   20 × 30
4 0 0 0   20 × 200
2 0 0 0 0   20 × 1,000
2 5 9 3 5   21 × 1,235</td>
<td>Use compact column multiplication with understanding of place value at all stages.

1 2 3 5
× 2 1
1 2 3 5   1 × 1,235
2 4 7 0 0   20 × 1,235
2 5 9 3 5   21 × 1,235</td>
</tr>
</table>

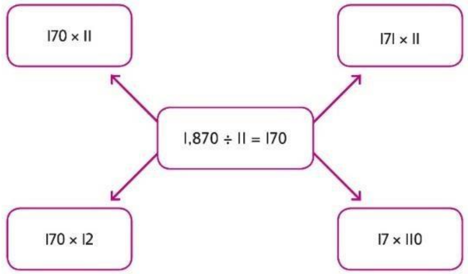
<table>
<tr>
<td>Using knowledge of factors and partitions to compare methods for multiplications</td>
<td>Use equipment to understand square numbers and cube numbers.



$5 \times 5 = 5^2 = 25$
$5 \times 5 \times 5 = 5^3 = 25 \times 5 = 125$</td>
<td>Compare methods visually using an area model. Understand that multiple approaches will produce the same answer if completed accurately.

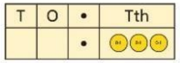
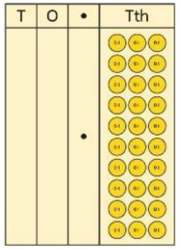
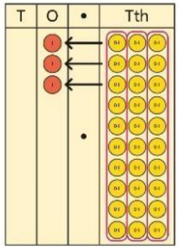
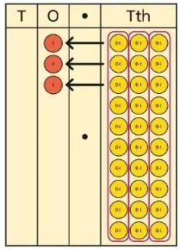
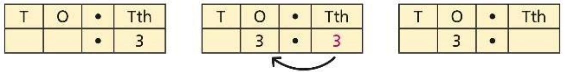


Represent and compare methods using a bar model.</td>
<td>Use a known fact to generate families of related facts.

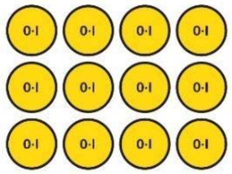


Use factors to calculate efficiently.

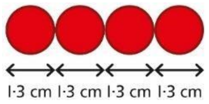
15×16
$= 3 \times 5 \times 2 \times 8$
$= 3 \times 8 \times 2 \times 5$
$= 24 \times 10$
$= 240$</td>
</tr>
</table>

Multiplying by 10, 100 and 1,000	Use place value equipment to explore exchange in decimal multiplication.  Represent 0·3.  Multiply by 10.  Exchange each group of ten tenths. *0·3 × 10 = ?* *0·3 is 3 tenths.* *10 × 3 tenths are 30 tenths.* *30 tenths are equivalent to 3 ones.*	Understand how the exchange affects decimal numbers on a place value grid.   *0·3 × 10 = 3*	Use knowledge of multiplying by 10, 100 and 1,000 to multiply by multiples of 10, 100 and 1,000. *8 × 100 = 800* *8 × 300 = 800 × 3* *= 2,400* *2·5 × 10 = 25* *2·5 × 20 = 2·5 × 10 × 2* *= 50*

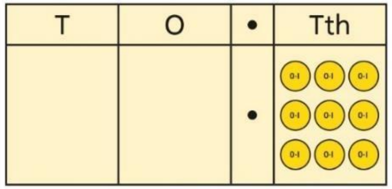
<table>
<tr>
<td>Multiplying decimals</td>
<td>
Explore decimal multiplications using place value equipment and in the context of measures.



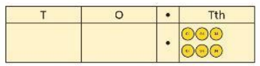
3 groups of 4 tenths is 12 tenths.
4 groups of 3 tenths is 12 tenths.

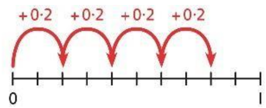


$4 \times 1 \text{ cm} = 4 \text{ cm}$
$4 \times 0\cdot3 \text{ cm} = 1.2 \text{ cm}$
$4 \times 1\cdot3 = 4 + 1\cdot2 = 5\cdot2 \text{ cm}$
</td>
<td>
Represent calculations on a place value grid.

$3 \times 3 = 9$
$3 \times 0\cdot3 = 0\cdot9$


Understand the link between multiplying decimals and repeated addition.





</td>
<td>
Use known facts to multiply decimals.

$4 \times 3 = 12$
$4 \times 0\cdot3 = 1\cdot2$
$4 \times 0\cdot03 = 0\cdot12$

$20 \times 5 = 100$
$20 \times 0\cdot5 = 10$
$20 \times 0\cdot05 = 1$

Find families of facts from a known multiplication.

I know that 18 × 4 = 72.

This can help me work out:

$1\cdot8 \times 4 = ?$
$18 \times 0\cdot4 = ?$
$180 \times 0\cdot4 = ?$
$18 \times 0\cdot04 = ?$

Use a place value grid to understand the effects of multiplying decimals.

<table>
<tr><th></th><th>H</th><th>T</th><th>O</th><th>•</th><th>Tth</th><th>Hth</th></tr>
<tr><td>2 × 3</td><td></td><td></td><td>6</td><td>•</td><td></td><td></td></tr>
<tr><td>0·2 × 3</td><td></td><td></td><td>0</td><td>•</td><td>6</td><td></td></tr>
<tr><td>0·02 × 3</td><td></td><td></td><td></td><td>•</td><td></td><td></td></tr>
</table>
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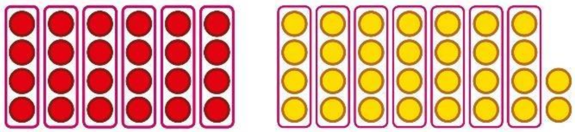
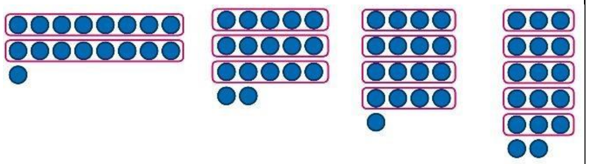
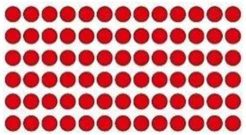
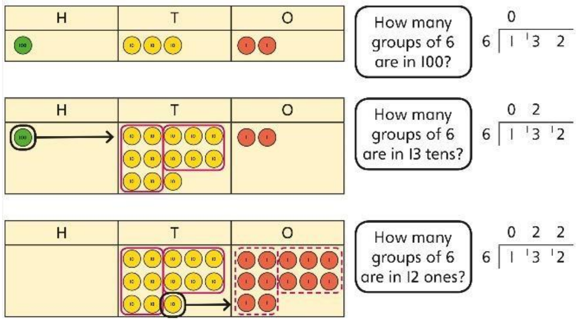
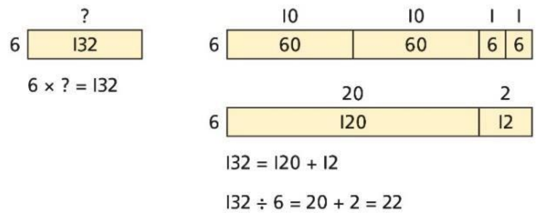
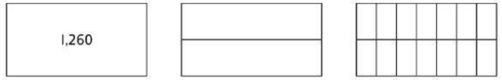
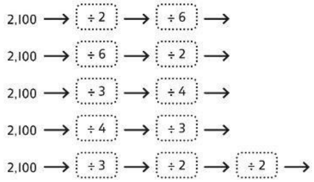
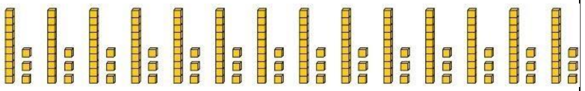
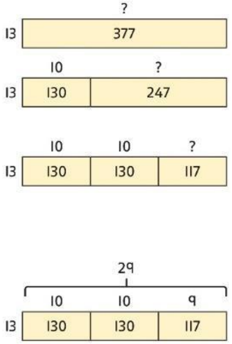
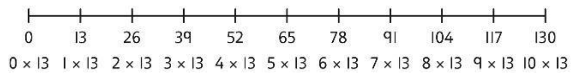
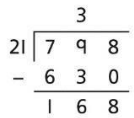
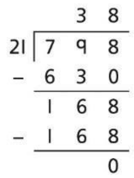
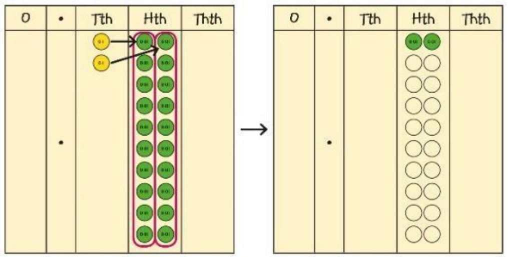
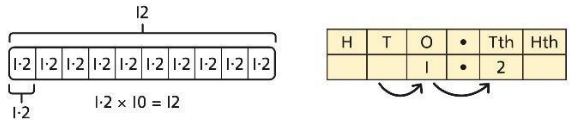
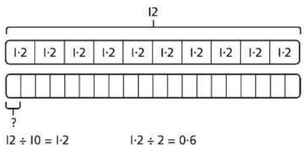
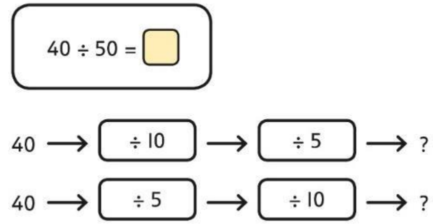
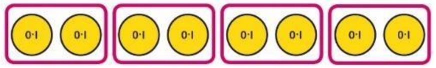
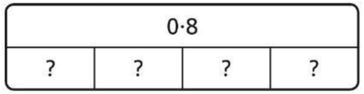
<table>
<tr><th>Year 6
Division</th><th>Concrete →</th><th>Pictorial →</th><th>Abstract</th></tr>
<tr>
<td>Understanding factors</td>
<td>Use equipment to explore different factors of a number.

24 ÷ 4 = 6   30 ÷ 4 = 7 remainder 2
4 is a factor of 24 but is not a factor of 30.</td>
<td>Recognise prime numbers as numbers having exactly two factors. Understand the link with division and remainders.

17 ÷ 2 = 8 r 1   17 ÷ 3 = 5 r 2   17 ÷ 4 = 4 r 1   17 ÷ 5 = 3 r 2</td>
<td>Recognise and know primes up to 100. Understand that 2 is the only even prime, and that 1 is not a prime number.
<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
<tr><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td><td>37</td><td>38</td><td>39</td><td>40</td></tr>
<tr><td>41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td></tr>
</table></td>
</tr>
<tr>
<td>Dividing by a single digit</td>
<td>Use equipment to make groups from a total.

There are 78 in total.
There are 6 groups of 13.
There are 13 groups of 6.</td>
<td>
</td>
<td>Use short division to divide by a single digit.
$\begin{array}{r} 0\phantom{\;{}^{1}3\;2} \\ 6\overline{)1\;{}^{1}3\;2} \end{array}$
$\begin{array}{r} 0\;2 \\ 6\overline{)1\;{}^{1}3\;{}^{1}2} \end{array}$
$\begin{array}{r} 0\;2\;2 \\ 6\overline{)1\;{}^{1}3\;{}^{1}2} \end{array}$
Use an area model to link multiplication and division.

</td>
</tr>
</table>

Dividing by a 2-digit number using factors	Understand that division by factors can be used when dividing by a number that is not prime.	Use factors and repeated division. *1,260 ÷ 14 = ?*  *1,260 ÷ 2 = 630* *630 ÷ 7 = 90* *1,260 ÷ 14 = 90*	Use factors and repeated division where appropriate. *2,100 ÷ 12 = ?* 
Dividing by a 2-digit number using long division	Use equipment to build numbers from groups.  *182 divided into groups of 13.* *There are 14 groups.*	Use an area model alongside written division to model the process. *377 ÷ 13 = ?*  *377 ÷ 13 = 29*	Use long division where factors are not useful (for example, when dividing by a 2-digit prime number). Write the required multiples to support the division process. *377 ÷ 13 = ?*  13 ⟌ 3 7 7 − 1 3 0 10 2 4 7 − 1 3 0 10 1 1 7 − 1 1 7 9 0 29 *377 ÷ 13 = 29*

			A slightly different layout may be used, with the division completed above rather than at the side.   Divisions with a remainder explored in problem-solving contexts.
Dividing by 10, 100 and 1,000	Use place value equipment to explore division as exchange.  Exchange each 0·1 for ten 0·01s. Divide 20 counters by 10. *0·2 is 2 tenths.* *2 tenths is equivalent to 20 hundredths. 20 hundredths divided by 10 is 2 hundredths.*	Represent division to show the relationship with multiplication. Understand the effect of dividing by 10, 100 and 1,000 on the digits on a place value grid.  Understand how to divide using division by 10, 100 and 1,000. *12 ÷ 20 = ?* 	Use knowledge of factors to divide by multiples of 10, 100 and 1,000.  *40 ÷ 5 = 8* *8 ÷ 10 = 0·8* *So, 40 ÷ 50 = 0·8*

Dividing decimals	Use place value equipment to explore division of decimals.  *8 tenths divided into 4 groups. 2 tenths in each group.*	Use a bar model to represent divisions.  4 × 2 = 8 8 ÷ 4 = 2 So, 4 × 0·2 = 0·8 0·8 ÷ 4 = 0·2	Use short division to divide decimals with up to 2 decimal places.