MATHS CALCULATION POLICY

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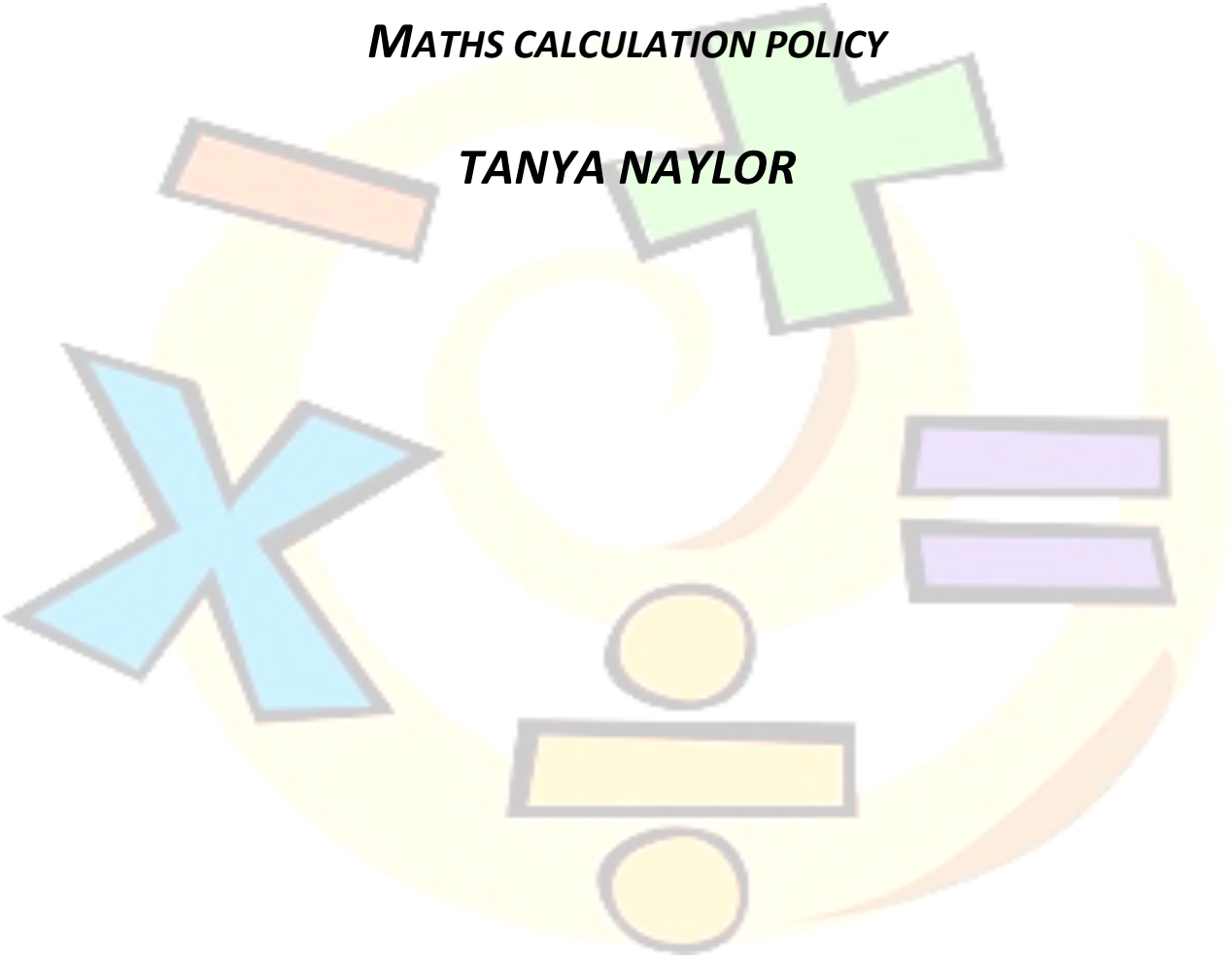


Updated September 2023

Age Related Expectations

Mental and Written Methods (Addition and Subtraction)

Year					
1	**2**	**3**	**4**	**5**	**6**
Read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs Solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = ☐ – 9	*Add and subtract two two-digit numbers using concrete objects, pictorial representations progressing to formal written methods* Add and subtract numbers using concrete objects, pictorial representations, and mentally, including: * a two-digit number and ones * a two-digit number and tens * two two-digit numbers adding three one-digit numbers	Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction Add and subtract numbers mentally, including: * a three-digit number and ones * a three-digit number and tens a three-digit number and hundreds	Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition where appropriate signs Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why	Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction) Add and subtract numbers mentally with increasingly large numbers	Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why Perform mental calculations, including with mixed operations and large numbers

Mental and Written Methods (Multiplication and Division)

Year					
1	**2**	**3**	**4**	**5**	**6**
Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher	Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts	Write and calculate mathematical statements for ÷ using the x tables they know progressing to formal written methods. Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental methods Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers Recognise and use factor pairs and commutativity in mental calculations	Multiply two-digit and three-digit numbers by a one-digit number using formal written layout	Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context Multiply and divide numbers mentally drawing upon known facts Multiply and divide whole numbers and those involving decimals by 10, 100 and 1000	Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication Divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division where appropriate for the context Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context Perform mental calculations, including with mixed operations and large numbers

Number Facts

Year					
1	**2**	**3**	**4**	**5**	**6**
Represent & use number bonds and related subtraction facts within 20 Add and subtract one-digit and two-digit numbers to 20, including zero	Recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100 Recall and use x and ÷ facts for the 2, 5 and 10 x tables, including recognising odd and even numbers.	Recall and use x and ÷ facts for the 3, 4 and 8 times tables.	Recall x and ÷ facts for x tables up to 12 x 12.	Recall prime numbers up to 19 Know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers Recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3})	Recall x and ÷ facts for x tables up to 12 x 12 and use to find other related facts

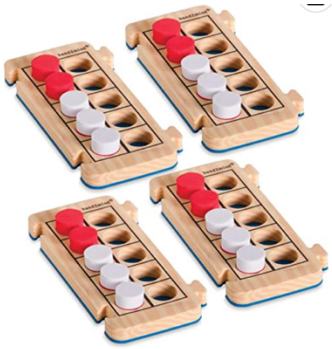
All staff at DJS follow this calculation policy in line with where the children are in their learning. The mathematics co-ordinator monitors this policy through lesson observations, planning scrutiny and book looks each term.

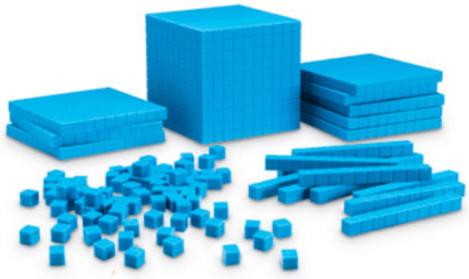
Throughout the teaching of mathematics at DJS, manipulatives are used to help children understand concepts taught. Both concrete and pictorial representations are used. Manipulatives are readily available in classes with extra resources situated in the main building.

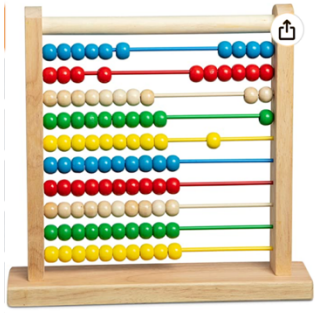
Manipulatives that are available and can be used are:

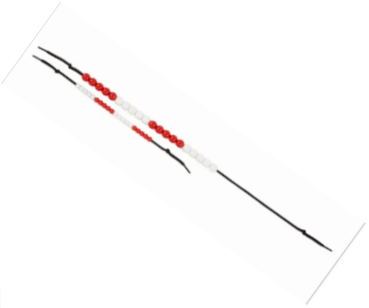
counters, tens frames, numicon, dice, unifix/multilink, diennes, abacus, number charts, number lines, number beads, place value counters, rekenrek frames, place value charts, counting sticks

This list is not exhaustive and is continually updated.









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

Progression of Written Methods for Addition

The aim is that children use mental methods when appropriate but for calculations that they cannot do in their heads they need to use an efficient written method accurately and confidently. Children will work towards using the standard written method of addition, working through some or all of these stages, dependent on their mathematical ability and understanding.

To add successfully, children need to be able to:

- *Recall all addition pairs to 9 + 9 and complements in 10;*
- *Add mentally a series of single-digit numbers, such as 5 + 8 + 4;*
- *Add multiples of 10 and 100, such as 60 + 70, 600 + 700, using related addition facts, 6 + 7, and their knowledge of place value;*
- *Partition two-digit, three digit and four digit numbers into multiples of 1000, 100, 10 and 1 in different ways.*

Expanded Vertical addition

Once confident with using number lines, children move onto expanded vertical addition, using partitioning and place value. The order of columns is important; units first, then tens, then hundreds etc

$$
\begin{array}{rl}
 & 47 \\
+ & 35 \\
\hline
 & 12 \quad (7 + 5) \\
 & 70 \quad (40 + 30) \\
\hline
 & 82
\end{array}
$$

$$
\begin{array}{rl}
 & 374 \\
+ & 248 \\
\hline
 & 12 \quad (4 + 8) \\
 & 110 \quad (70 + 40) \\
 & 500 \quad (300 + 200) \\
\hline
 & 622
\end{array}
$$

Formal Method of Columnar Addition

Finally, the formal method is taught with several phases. Add from smallest place value column first and work to the left. Once this method is learnt, it is quick and reliable and will be used throughout the children's education.

1) No bridging of tens.

$$\begin{array}{r} 23 \\ +\ 35 \\ \hline 58 \end{array}$$ (3 + 5, 2+ 3)

2) Bridging tens. Carry ten into next column. Record ten underneath.

$$\begin{array}{r} 47 \\ +\ 34 \\ \hline 81 \\ 1 \end{array}$$ (7 + 4, 4+ 3 + 1)

3) Progression is then made by bridging tens, hundreds, thousands etc.

$$\begin{array}{r} 789 \\ +\ 642 \\ \hline 1431 \\ 1\ 1 \end{array} \qquad \begin{array}{r} 5735 \\ +\ 562 \\ \hline 6297 \\ 1 \end{array}$$

4) Finally addition of decimals and mixed numbers – knowledge of place value is paramount.

$$\begin{array}{r} 23.70 \\ +\ 48.56 \\ \hline 72.26 \\ 1\ 1 \end{array} \qquad \begin{array}{r} 3.243 \\ +18.070 \\ \hline 21.313 \\ 1\quad 1 \end{array}$$

Progression of Written Methods for Subtraction

The aim is that children use mental methods when appropriate but for calculations that they cannot do in their heads they need to use an efficient written method accurately and confidently. Children will work towards using the standard written method of subtraction, working through some or all of these stages, dependent on their mathematical ability and understanding.

To subtract successfully, children need to be able to:

- *Recall all addition and subtraction facts to 20;*
- *Subtract multiples of 10, such as 160 – 70, using the related subtraction fact 16 – 7, and their knowledge of place value;*
- *Partition two-digit, three-digit and four-digit numbers into multiples of one thousand, one hundred, ten and one in different ways, e.g. partition 74 into 70 + 4 or 60 + 14.*

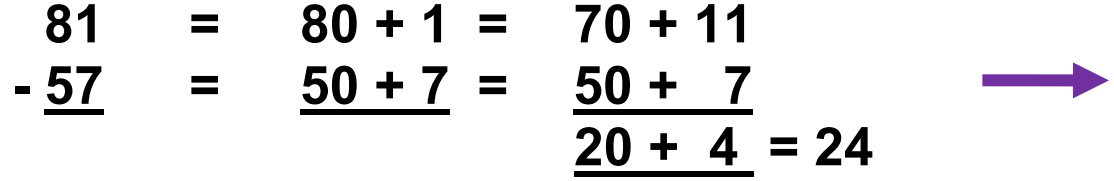
Progression to Formal Columnar Method

At first children are taught the columnar method without decomposition (exchanging).

These methods are taught side by side so children have a secure understanding through place value what is happening to all digits.

874 – 523 = 351

Once proficient with this method they extend to decomposition. Again methods are taught side by side. Children need to use the correct language – they ***EXCHANGE***, they do not borrow!



$$\begin{array}{r} 7\ 11 \\ \cancel{8}\ \cancel{1} \\ -\ 5\ 7 \\ \hline 2\ 4 \end{array}$$

Note language used:

1 takeaway 7 you cannot do, go next door to the tens and EXCHANGE one ten for ten units. 7 tens now become 6 tens and 1 unit now becomes 11 units.

Progression in subtraction :

TU – TU
HTU – TU
HTU – HTU
ThHTU – TU
ThHTU – HTU
ThHTU – ThHTU

Subtraction of decimals

Progression of Written Methods for Multiplication

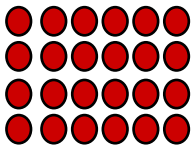
The aim is that children use mental methods when appropriate but for calculations that they cannot do in their heads they need to use an efficient written method accurately and confidently. Children will work towards using the standard written method of multiplication, working through some or all of these stages, dependent on their mathematical ability and understanding.

To multiply successfully, children need to be able to:

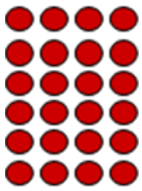
- *Recall all multiplication facts to 12 x 12;*
- *Partition numbers into multiples of one hundred, ten and one;*
- *Work out products such as 70 x 5, 70 x 50, 700 x 50, using their knowledge of related fact, 7 x 5, and of place value.*
- *Add multiples of 10, such as 60 + 70, or of 100, such as 600 + 700, using the related addition facts, 6 + 7, and their knowledge of place value;*
- *Add combinations of whole numbers using the column method.*

Use of Arrays for multiplication facts up to 12 X 12

6 X 4 = 24



4 X 6 = 24



Calculating statements using the multiplication tables they know

Children break down statements using multiples of ten and related facts.

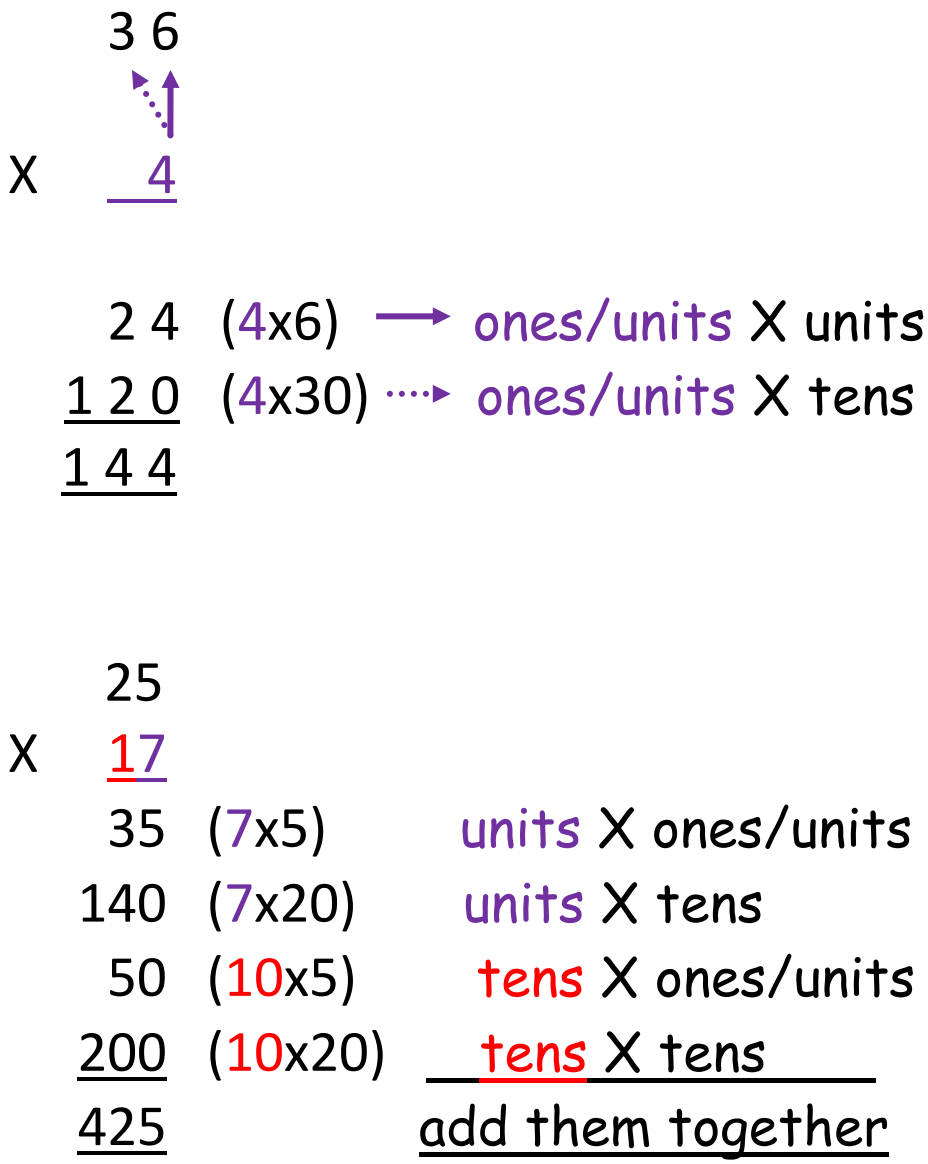
36 X 4 = 144

10 X 4 = 40
10 X 4 = 40
10 X 4 = 40
6 X 4 = 24
144

30 X 4 = 120
6 X 4 = 24
144

Progression to Formal Columnar Method – Expanded Method

Before children move onto the short formal method of multiplication, they will set out their calculations in an expanded form, focusing on the correct order of digits to multiply and having a clear understanding of place value.



Formal Method of Multiplication

Once children have a secure understanding of the expanded method, they will progress onto the formal method of multiplication.

```
   3 6
X    4
  14 4
   2
```

carry 2 under the line and keep in correct column

Children will then progress onto HTU X U before TU X TU.

```
    25
X   17
   175
  250
   425
```

(units times the units, then the units times the tens)

(start a new line because you are multiplying by 10; put in the place value zero)

(tens times the units, then the tens times the tens)

(add them together)

Further progression of multiplication:

HTU X TU
ThHTU X TU
4 digits (including decimals) X U
4 digits (including decimals) X TU

Progression of Written Methods for Division

The aim is that children use mental methods when appropriate but for calculations that they cannot do in their heads they need to use an efficient written method accurately and confidently. Children will work towards using the standard written method of division, working through some or all of these stages, dependent on their mathematical ability and understanding.

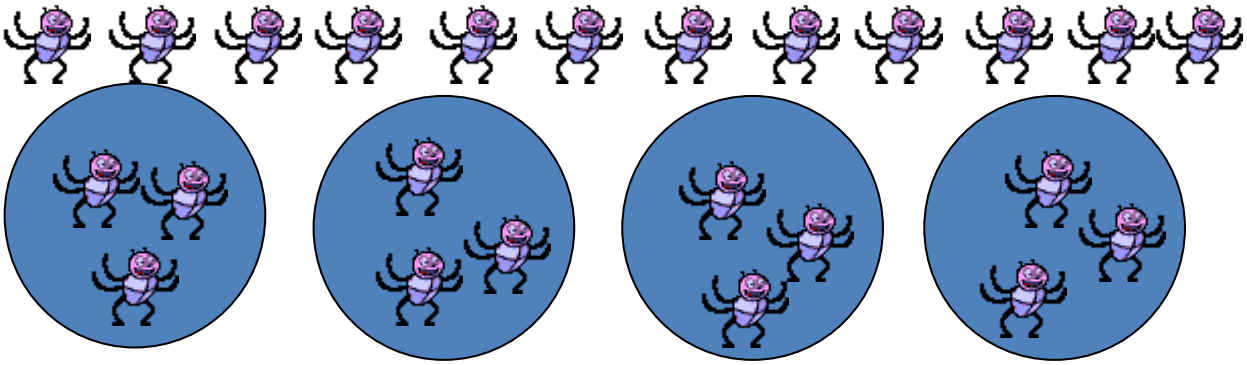
To divide successfully, children need to be able to:

- *Understand and use the vocabulary of division, e.g. in 18 ÷ 3 = 6, the 18 is the dividend, the 3 is the divisor and the 6 is the quotient;*
- *Partition two-digit and three-digit numbers into multiples of one hundred, ten and ones in different ways;*
- *Recall multiplication and related division facts to 12 x 12, recognise multiples of single-digit numbers, and divide multiples of 10 or 100 by a single-digit number using their knowledge of division facts and place value;*
- *Know how to find a remainder working mentally, e.g. find the remainder when 48 is divided by 5;*
- *Subtract effectively;*
- *Understand and use multiplication and division as inverse operations.*

Grouping objects into equal groups and relate this to multiplication

To begin with children will use concrete objects, putting them into equal groups. The relationship to multiplication will be reinforced at all times.

12 ÷ 4 =



12 ÷ 4 = 3 because 4 X 3 = 12

Progression to Formal Method

Before children move onto the short or long formal method of division, they will expand on their knowledge of times tables to help solve simple problems, with and without remainders, using multiples of the divisor.

$$16 \div 2 \neq 2 \div 16$$

$$16 \div 2 = 8 \text{ because } 2 \times 8 = 16$$

$$21 \div 5 = 4 \text{ remainder } 1$$

$$5 \times 4 = 20$$

$$20 + 1 = 21$$

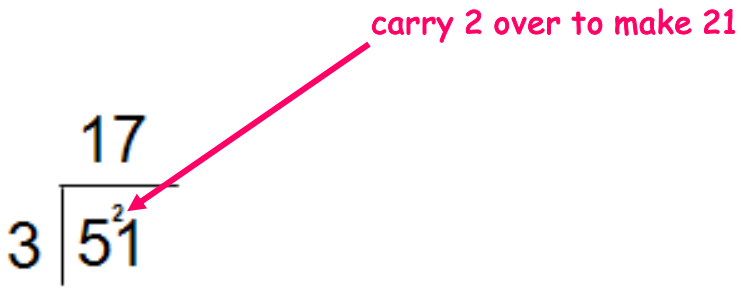
$$85 \div 5 = 17$$

$$\begin{array}{r} 10 \times 5 = 50 \\ 7 \times 5 = 35 \\ \hline 17 \qquad 85 \end{array}$$

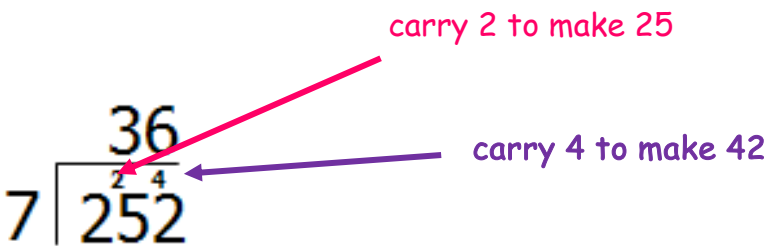
Formal Method of Short Division

Once children have a clear understanding of using multiples of the divisor (2-12), children will be taught the short method of division for divisors 2-12.

51 ÷ 3 = 17

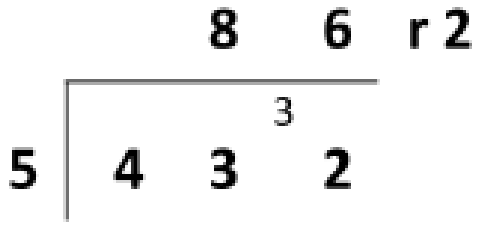


252 ÷ 7 = 36



Progress to remainders

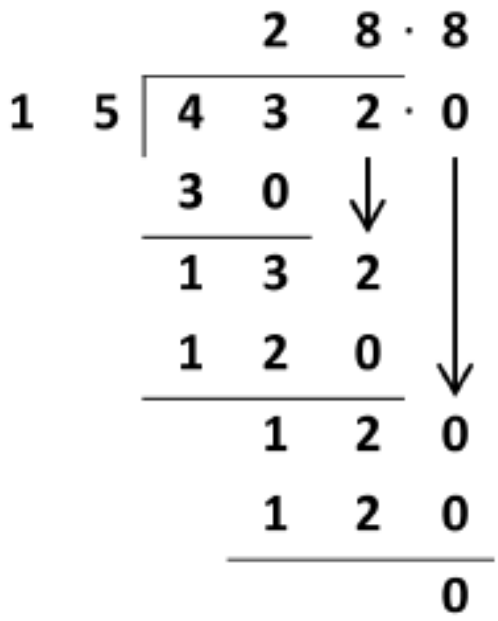
432 ÷ 5 = 86 r 2



Formal Method of Long Division

Dividing by divisors not in times tables up to 12, children will be taught the standard method of long division. Secure ability to multiply the divisor will be need for this method.

$432 \div 15 = 28.8$



Remainders will be taught as decimals, fractions and remainders when using the standard long division method.

Fractions Progression

<table>
<tr><th colspan="6">ADDITION AND SUBTRACTION OF FRACTIONS</th></tr>
<tr><th>Year 1</th><th>Year 2</th><th>Year 3</th><th>Year 4</th><th>Year 5</th><th>Year 6</th></tr>
<tr><td></td><td></td><td>add and subtract fractions with the same denominator within one whole e.g. $^{5}/_{7} + {}^{1}/_{7} = {}^{6}/_{7}$</td><td>add and subtract fractions with the same denominator</td><td>add and subtract fractions with the same denominator and multiples of the same number
recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number e.g. $^{2}/_{5} + {}^{4}/_{5} = {}^{6}/_{5} = 1\,{}^{1}/_{5}$</td><td>add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions</td></tr>
<tr><th colspan="6">MULTIPLICATION AND DIVISION OF FRACTIONS</th></tr>
<tr><td></td><td></td><td></td><td></td><td>multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams</td><td>multiply simple pairs of proper fractions, writing the answer in its simplest form e.g. $^{1}/_{4} \times {}^{1}/_{2} = {}^{1}/_{8}$
multiply one-digit numbers with up to two decimal places by whole numbers</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>divide proper fractions by whole numbers e.g. $^{1}/_{3} \div 2 = {}^{1}/_{6}$</td></tr>
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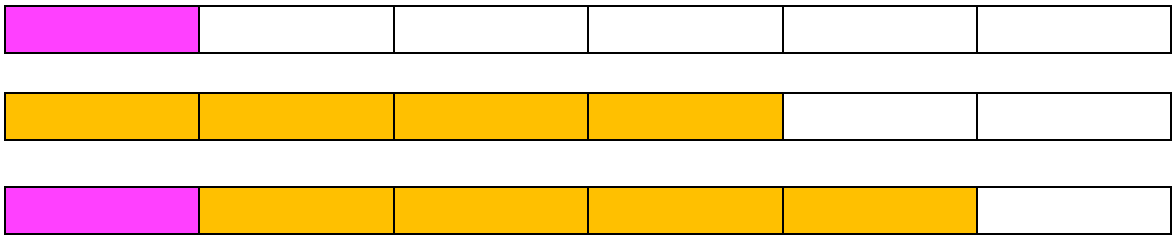
Addition of Fractions

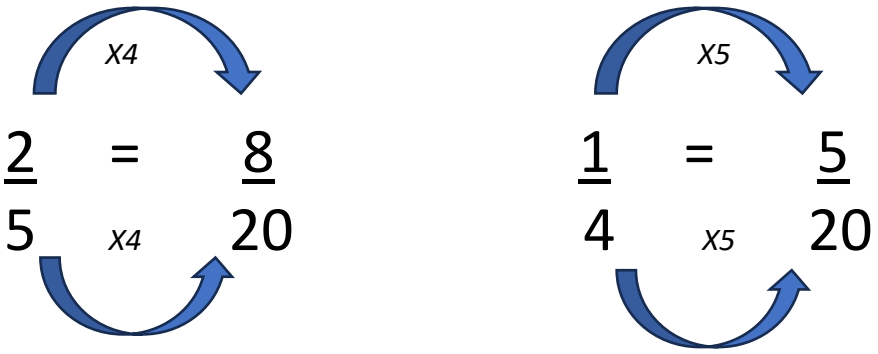
At first, addition of fractions using the same denominators. Use of pictorial representations and manipulatives are used to help with understanding.



$$\frac{1}{6} + \frac{4}{6} = \frac{5}{6}$$

Progression to moving onto addition of fractions with different denominators. To add these fractions, the lowest common denominator(LCD) is used.

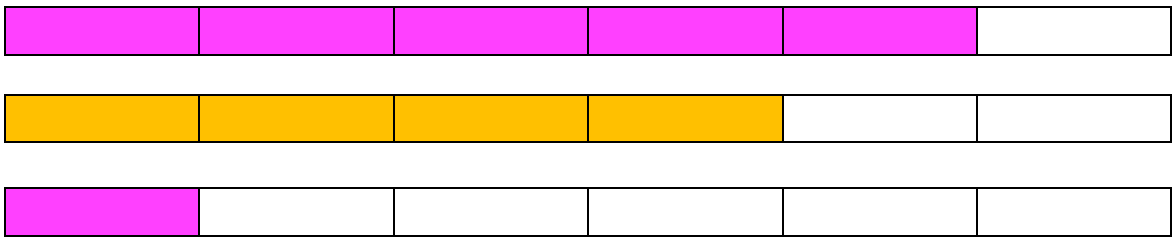
$$\frac{2}{5} + \frac{1}{4}$$



$$\frac{8}{20} + \frac{5}{20} = \frac{13}{20}$$

Subtraction of Fractions

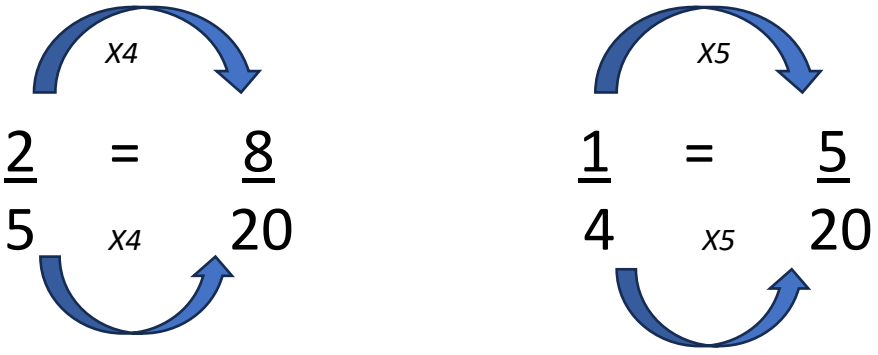
At first subtraction of fractions using the same denominators. Use of pictorial representations and manipulatives are used to help with understanding.



$$\frac{5}{6} - \frac{4}{6} = \frac{1}{6}$$

Progression to moving onto subtraction of fractions with different denominators. To subtract these fractions, the lowest common denominator(LCD) is used.

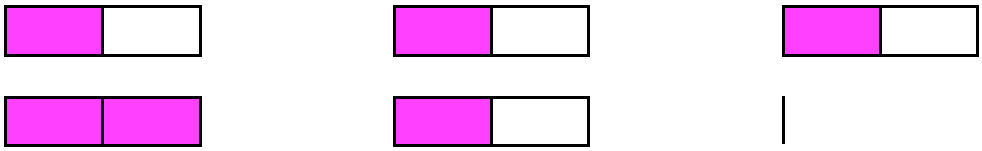
$$\frac{2}{5} - \frac{1}{4}$$



$$\frac{8}{20} - \frac{5}{20} = \frac{3}{20}$$

Multiplication of Fractions

When multiplying fractions, you multiply fractions by whole numbers first. Pictorial representations are used to help with this.



$$\frac{1}{2} \times 3 = \frac{3}{2} = 1\frac{1}{2}$$

Progression onto multiplying 2 fractions. Multiply the numerator by the numerator and the denominator by the denominator. Fractions are then simplified. Pictorial representations are used to help with this.

X the numerators

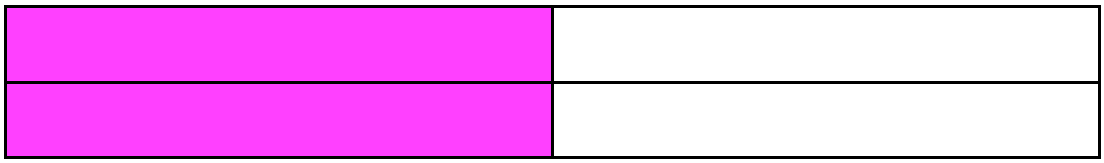
simplify

$$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$$

X the denominators

Division of Fractions

Division of fractions by whole numbers. When dividing fractions by a whole number, multiply the denominator. Start with unit fractions.



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

Progression onto non-unit fractions. Simplify if needed.

$$\frac{3}{4} \div 2 = \frac{3}{8}$$

X the denominator with the divisor

simplify

$$\frac{3}{7} \div 3 = \frac{3}{21} = \frac{1}{7}$$

X the denominator with the divisor