Stretton Sugwas Academy

Calculation Policy

Reviewed: Autumn 2016

Mr B Ford

Introduction

This Calculation Policy is to be used in conjunction with the school's "Maths 5-A-Day" guide, which suggests how parents and carers can support their child's Mathematical development in the home setting. The information provided in this policy outlines important key concepts from the Early Years to Year 6 and how such concepts are taught in school, meaning that parents/carers can feel more confident in supporting their child's learning of "the essentials".

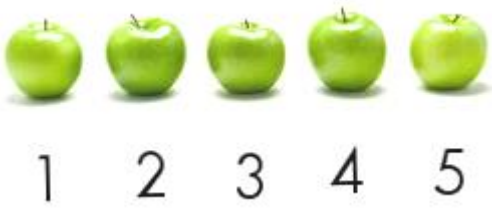
These essentials are necessary for children to move onto more difficult concepts. This document does not cover the whole Maths curriculum. If you require additional work to challenge your child, please see your child's class teacher. Conversely, there may be times when children struggle with certain methods, in these cases we would look at alternatives in order for the children to progress.

1 Number and Place Value Skills

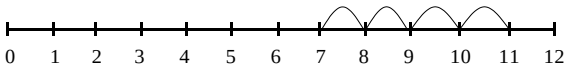
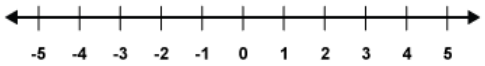
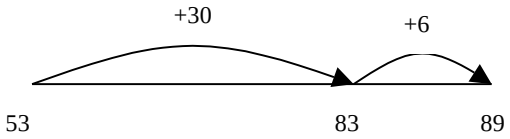
Number Line (inc Negatives)

In the Early Years, children's first steps will be to create a number line using real-life objects to count correctly. Adding and subtracting can be done by physically adding more items to the line or taking them away to count what new amount has been made. EYFS pupils can do 3+2 by setting out that sum that they hear or read.

3+2=



The next step will be for children to move away from physical, "concrete", objects to a written representation to help solve addition and subtraction problems.

Numbered Number Line	Empty Number Line
For problems involving lower numbers, children will use the skill of counting on/back using a numbered number line. 7+4= (or 11-4=)  When at the later stage of working with negative numbers, a horizontal number line will be drawn (see below). Pupils will be taught to draw their number line vertically when working with problems involving temperature. 	For problems involving higher numbers, children will need to have good knowledge of number bonds as well as counting in 10s or 100s to count on using an empty number line. 53+36= (or 89-53=) (or even 53+?=89)  When children use this strategy involving a negative number, they must be shown where to put a zero.

Partitioning (and Columns)

Children will progress from using single digit numbers to working with numbers up to 7-digits in Year 6. Partitioning is the ability to split the digits of a number into their separate values.

83+42 = 125

3 + 2 = 5 (Add the Units)

80 + 40 = 120 (Add the Tens)

120 + 5 = 125 (Add the Totals)

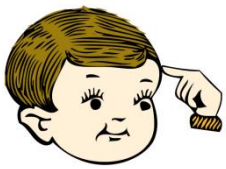
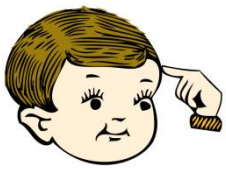
Key to any partitioning work, and any problems involving the "values" or "worth" of digits, will be the names

of the columns (see below). This will be crucial when children begin to explore using formal written methods of calculation, such as column addition or subtraction. Additionally, when working with thousands, children must be taught the correct use of a comma per 1,000.

M	HTh	TTh	Th	H	T	U	1/10	1/100	1/1000
1,000,000	100,000	10,000	1,000	100	10	1	0.1	0.01	0.001
		1	1	4	6	7	9	5	4

Mental Work

Our aim is for children to be quick at arithmetic and calculations. This will be achieved through giving children opportunities to solve problems mentally.

Counting On/Back		Partitioning	
	12 +5 = *"12 is the bigger number. Keep that in my head. Add on 5 with my fingers...17."*		26+455= *"455 is the bigger number. Keep that in my head. Add the 6 first. 461. Now add the 20...481."*

An important skill to be taught as children develop their ability to work like this mentally will be to count on (or back) in 10s, 100s and 1,000s.

Roman Numerals

Children will be taught the following mnemonic to remember the order of the numerals and their values:
Major Davies Cooked Lots of eXtra Vegetables Intensely

M	D	C	L	X	V	I
1000	500	100	50	10	5	1

In Roman numerals, there will never be more than three of the same numeral in a row. Also, big numbers come first and are added to each other. If a smaller number comes before a bigger one, it is taken away instead of added on. For example, XXII is 22. XXIX is 29. Children will be taught to put the value of the numeral above the numeral itself, before working it out from left to right. For example, for the number CCXCIX:

100	100	10	100	1	10	
C	C	X	C	I	X	

Thousands first. There are none. Hundreds next, starting from the left. 200. Tens next. There is a 10 before a 100, making 90. Units next. There is a 1 before a 10, making 9. Altogether, 299.

Rounding

In order to round, pupils will need to have a secure understanding of the "names" of columns (see partitioning section and below). Pupils may be asked to round a number to the nearest hundred or to 2 decimal places (which means 2 places after the decimal point).

"Round 11,467.954 to the nearest hundred."

Pupils are taught to put a line under the column they are being asked to "round to" (starting from left to

right). In this example, the digits 114 are underlined. Children are also taught to look to the next column to see whether they have enough to "round up" (any digit 5 or more will allow this). The 114 can be rounded up to 115 and all the other digits (not underlined) can become 0. The finished answer is 11,500.000

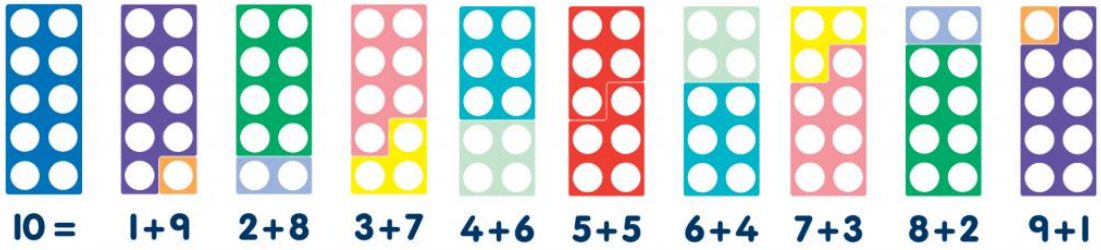
M	HTh	TTh	Th	H	T	U	1/10	1/100	1/1000
1,000,000	100,000	10,000	1,000	100	10	1	0.1	0.01	0.001
		1	1	4	6	7	9	5	4

Children will also be given opportunities to round to the nearest multiple, for example, of 50 or 500.

2 Number Bonds, Facts and Tables

Number Bonds

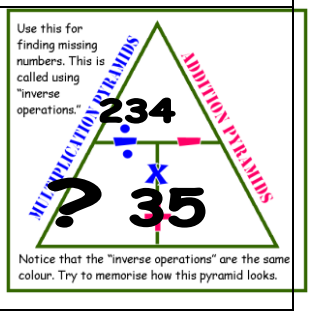
Number bonds are the building blocks of the columnar methods of calculation. Hands-on resources such as Numicon and counting beads are used in the Early Years to help develop this concept. These must also be learnt and consolidated by rote. It is essential that children confidently know their number bonds to 100 at speed, including numbers less than 100, by the end of Year 2.



Subtraction Facts

Children are taught the relationship between the 3 numbers that make up a number bond. For example, 4+6=10 meaning that 10-6=4 or 10-4=6. In EYFS, children explore this using real objects, such as toys or Numicon.

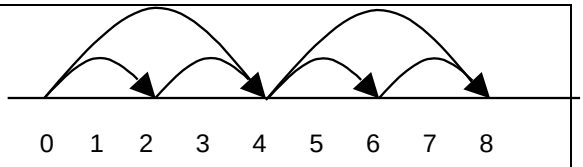
This concept is then extended from Year 3 using the triangular method shown right. 234-?=35. By placing the numbers in the triangle, the answer can be found by 234-35.



Times Tables

From Year 1, children use repeated addition with real objects, dots or pictures or a number line starting at zero. This is to develop their awareness of counting on in groups of the same number.

Arrays	Repeated Addition
4x2=? ● ● ● ● 4 x 2 or 4 x 2 or 4 + 4 ● ● ● ● 2 x 4	4x2=? 2 + 2 + 2 + 2



Multiplication grids and more formal times tables charts can be used to build up pupils' rapid recall of their tables to 12x12. Children are expected to know their tables by the end of Year 4.

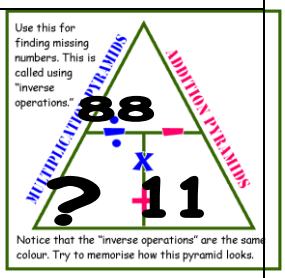
Times Table Expectations

Year	Multiplications
1	2, 5, 10
2	2, 3, 5, 10
3	2, 3, 4, 5, 8, 10
4	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Multiplication and Division Facts

Children are taught the relationship between the 3 numbers that make up a multiplication fact: the two factors and the product. For example, 3x4=12 meaning that 12÷3=4 or 12÷4=3. As shown in the previous section, real objects, pictures and sharing dots (arrays) can be used to introduce this concept for younger children.

This concept may then be extended from Year 3, depending on tables knowledge, using the triangular method shown right. 88 ÷ ?= 11. By placing the numbers in the triangle, the answer can be found by 88 ÷ 11.



Factors, Products, Multiples, Square and Prime Numbers

Children must develop fluency and confidence with the following terms:

Factors: Numbers that, when multiplied, make another number.

Products: the number that is made when two other numbers are multiplied together.

Multiples: Numbers that are in the same times table as a stated number.

Square Numbers: Its factors are the same number.

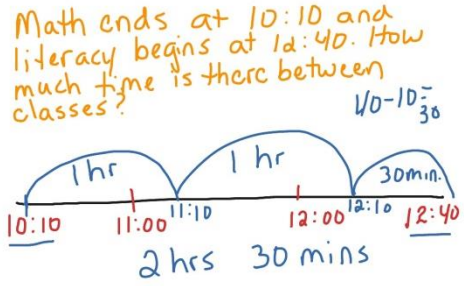
Prime Numbers: Numbers that only have 2 factors, itself and 1.

3 Shape, Space and Measure

Time

Children must develop fluency and confidence with the days of the week, months of the year, seasons, times of the day or daily routine. As soon as children start school, they must begin to sequence and order events.

From Year 1 to Year 3, children will build on this by learning to tell the time. Years 4 to 6 will be converting times between analogue and digital clocks as well as solving problems involving time.

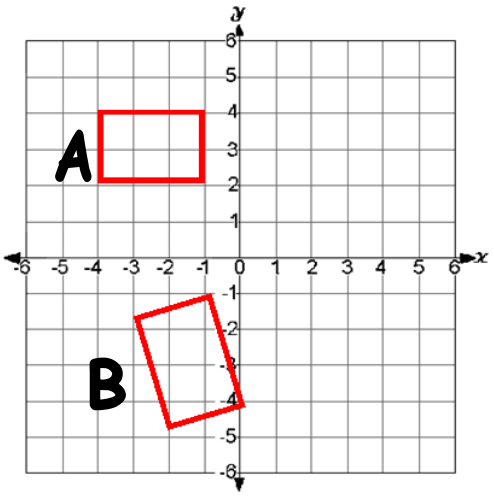
Timeline	
The empty number line is used to help pupils with questions involving time. Pupils will need to have a good grasp of how many minutes are in an hour as well as number bonds, especially to 60. Year 6 children will need to convert a time in minutes to hours and minutes. For example, 75 minutes = 1 hour 15 minutes.	

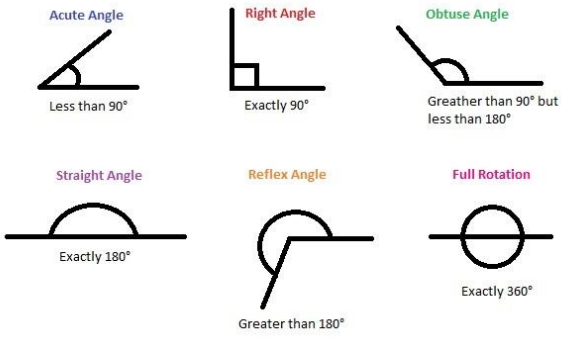
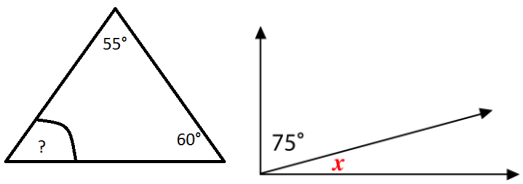
Converting Time
Children should be taught that a digital time will always have 4 digits, like this - 08:00. If it is a 12 hour clock, it will have am or pm. Am means before midday, pm means after it. If the time is on a 24 hour clock, the day starts at 00:00 and ends at 23:59. The only difference is you may need to add 12 to your 12 hour time if it is p.m. It is recommended that children have as much additional experience of telling the time at home as possible, reading both analogue and digital times to develop confidence.

Rulers, Tapes and Scales	
In order to develop the concept of size and quantity from an early age, children should have additional experience of measuring outside of school. This may be weighing ingredients with parents for a recipe, measuring height for new clothes, measuring plant growth or other similar activities.	
Older children will be taught to look at 2 numbers on the scale, counting how many jumps there are between them and working out how much each jump is worth. In the example (right), between 50 and 60 there are 5 sections. That means, for a difference of 10, there are 5 sections. 10 divided by 5 equals 2. Each section must be worth 2. The arrow is pointing at 54.	

2D and 3D shapes
As younger children develop their awareness of the names of common 2D and 3D shapes, the next step is to develop fluency and confidence with the following terms: Angles Faces Sides Edge Vertex (Corner)

Lines of Symmetry

Co-Ordinates	
Children will be taught that co-ordinates have the X number first, then the Y. Remember: along the corridor, up the stairs. The co-ordinates of shape A are: (-1,2), (-4,2), (-4,4) and (-1,4). Children find difficulty with translation and rotation. Translation means you have to move the shape to another part of the graph. Rotation means that you keep one of its points the same and turn the shape.	

Angles	
Values of Angles	
In order to learn more difficult concepts, children need to know the main types of angle and their values, where applicable (see right). Children must also learn by rote that the angles of a triangle add up to 180° and 360° in a quadrilateral or circle.	
Values of Missing Angles	
In years 5 and 6, children will need to be able to use the knowledge in the previous section to calculate the values of "mystery" angles.	

Converting Measurements
To effectively convert cm to mm and m or even kg to g, children will need to know how many there are in each, for example how many cm are in 1 metre? Depending on whether the answer is 10, 100 or 1000, children must multiply or divide their starting measurement by this or will have to move any decimal 1,2,or 3 jumps (corresponding to the zeros in 10,100 or 1000) to make the number bigger or smaller.

4 Calculations

Adding (Column Addition)

As children progress through the school, they will move onto the formal written methods of column addition, stages of which are outlined below.

Stage 1

Use expanded layout without crossing the 10's boundary

HTU
358
+ 73
11
Add the Units
120
Add the Tens
300
Add the Hundreds
431

Stage 2

Extend to compact layout.

HTU
343
+ 245
588

Stage 3

Leading to formal method, showing numbers carried underneath.

HTU
358
+ 73
431
1 1

Stage 4

Introducing decimal numbers, showing the need to line up the decimal point correctly.

HTU
35.8
+ 7.3
43.1
1 1

Subtracting (Column Subtraction)

As children progress through the school, they will move onto the formal written methods of column subtraction, stages of which are outlined below.

Stage 1

Use expanded layout without crossing the 10's boundary

HTU
388
- 73
5

Stage 2

Extend to compact layout.

HTU
459
- 237
222

Stage 3 - Borrowing

Borrowing from the larger digit and recording the reminder

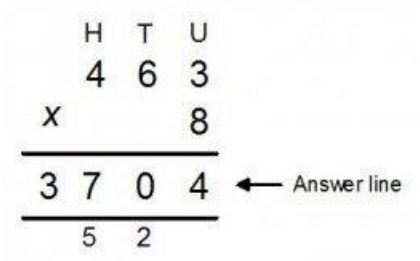
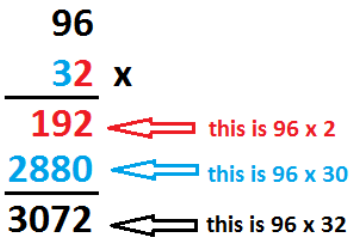
HTU
4 1
6 5 3

Stage 4 - Decimals

Introducing decimal numbers, showing the need to line up the decimal point correctly.

HTU
4 1
6.53
- 4.25

Subtract the Units 10 Subtract the Tens 300 Subtract the Hundreds 315 Add the total		- 425 228	2.28

Multiplication	
As children progress through the school, they will move onto the formal written methods of long and short multiplication. Proficient times table knowledge is essential for a secure grasp of these methods of calculation.	
Short Multiplication	Long Multiplication
The unit on the bottom line is multiplied by the unit on the top line, then the ten, then the hundred. Similar to column addition, if a total has 2-digits, the tens are carried over (see picture below for example).  	You need to set your calculation as below. Again, you multiply your top number by the units of the bottom number. Then you multiply by the tens column of the bottom number, adding a zero first. You then add your two separate answers together. 

Division	
As children progress through the school, they will move onto the formal written methods of long and short division. Proficient times table knowledge is essential for a secure grasp of these methods of calculation.	
Short Division	Long Division
"How many 7s go into 3? Zero. Carry the 3 over to the 6. How many 7s go into 36? 5 with 1 left over. Carry the 1 over to the 2. How many 7s go into 12? 1 with 5 left over. I have a remainder of 5."	The process of long division is generally the same but the main difference is that you have to set out your working a bit like a take away problem. If you look at the first entry, 24 goes into 85 3 times (which is 72). 85 – 72 is 12. Notice what happens to the 5. It drops to become 125 and the process happens again. You will also notice that children are

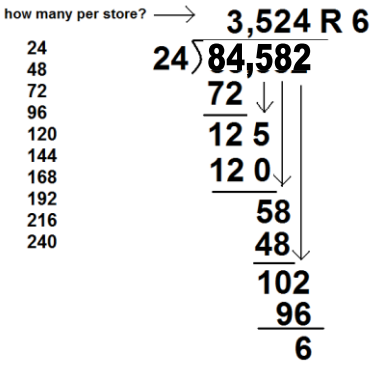
362 ÷ 7 =

5 1 r5

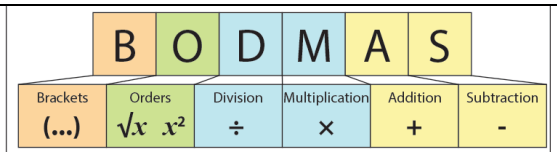
7 | 3 6 ¹2

362 ÷ 7 = 51 r5

encouraged to write the tables down the side if they are over 12x.



BODMAS



BODMAS stands for: Brackets, Orders, Division, Multiplication, Addition and Subtraction. It is a set order in which to perform calculations if there are more than one in a problem (see below).

For example: 2x4÷4-2=?

Any brackets? No.

Any orders? No.

Any division? Yes. Either side of the division sign is a 4. We do this first. 4÷4=1.

Our problem now reads 2x1-2=?

Any multiplication? Yes. 2x1 is 2.

Our problem now reads 2-2=?

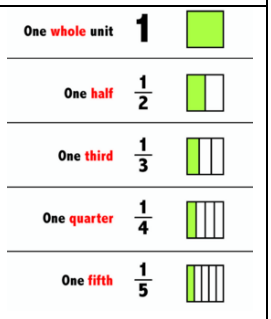
Any addition? No.

Any subtraction? Yes. 2-2. The answer is zero.

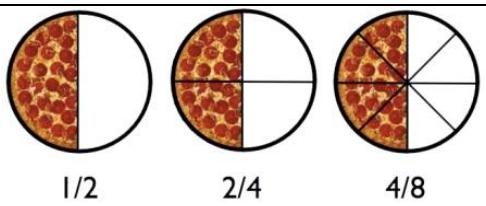
5 Decimals, Fractions and Percentages

Recognising Fractions

Children should begin to develop their awareness of fractions as early as possible through real-life situations and objects, such as: "*this cup is half full.*" From Year 1, children be taught how to read and name common fractions, understanding that the bottom number is the number of parts and the top number is the amount you have.



Equivalent Fractions Simplify Fractions

Once children have been introduced to fractions, they should be taught to identify halves and doubles of numbers, using pictures and diagrams. After this, the next step is to identify whether the top and bottom number in a fraction is in the same times table. Naturally, times table work runs alongside the development of this concept.	

Adding and Taking Away Fractions	
Same Denominator	Different Denominator
Children learn that, when adding and taking away fractions with the same denomnator, the denominator will stay the same. It's just the top number (the numerator) that will be added or taken away. See the examle below. $\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$	Children are taught that, when you add fractions, you MUST have a common denominator (the bottom number). To do this you look for a number that the denominators can both go into. What is 1/3 plus 1/5? They both go into 15. $\frac{1 \times 5}{3 \times 5} = \frac{5}{15}$ $\quad \frac{1 \times 3}{5 \times 3} = \frac{3}{15}$ Common Denominator

Multiply Fractions	
In order to multiply fractions, children are taught that the numerators are multiplied together and the denominators are multiplied together.	$\frac{2}{4} \times \frac{2}{4} = \frac{4}{16}$

Divide Fractions	
In order to divide fractions, children are taught that the numerator of the first fraction is multiplied by the denominator of the second fraction. The denominator of the first fraction is then multiplied by the numerator of the second fraction. Please see picture for an example.	$\frac{2}{3} \div \frac{1}{4} = \frac{8}{3}$

Equivalents and Converting

In order to develop more challenging concepts as well as greatly increase speed in both arithmetic and problem solving, children must learn by rote the decimal and percentage equivalencies of the fractions to the left.

Fraction	Percent	Decimal
1	100%	1.0
1/2	50%	0.5
1/3	33.3%	0.33
1/4	25%	0.25
1/5	20%	0.2
1/6	16.6%	0.166
1/8	12.5%	0.125
1/10	10%	0.1
1/12	8.3%	0.083