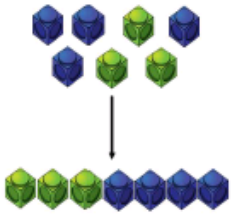
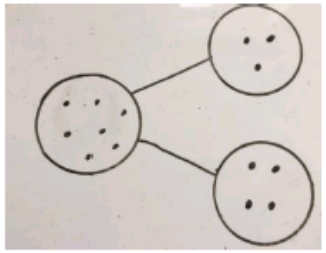
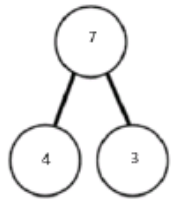
The Gates Primary School - Calculations Overview

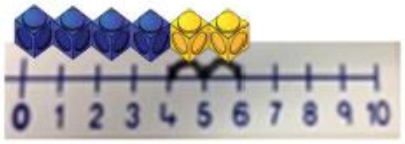
Notes:

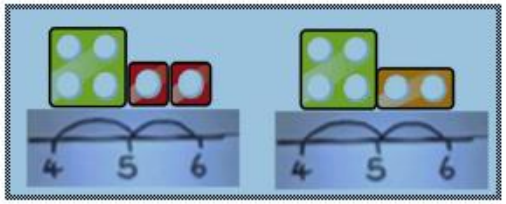
- All children should be exposed to concrete, pictorial and abstract methods as they secure their understanding. Some children will spend more time with different approaches.
  Following a CPA approach will allow children to deepen their understanding, understand the why and make links.
- Regular oral counting forwards and backwards from any starting number (inc decimals) to be done regularly.
- Continue to embed **arithmetic / mental skills** in starters, SUMS time, morning registration and through weekly arithmetic tests and feedback. Times tables should be the priority for SUMS time in Y2-4.
- Following our school LTPs & MTPs (**WRM**) & **use of Test Analysis** will indicate what objectives should be taught and when.
- **Bar Models** should be used alongside other presented forms as a way of helping with understanding. If chn are very familiar with Bar Model as they come through school, they will be able to use it to better effect to help with reasoning later on.

Addition +

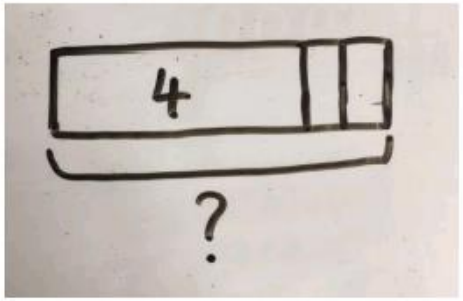
C	P	A
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars). 	Children to represent the cubes using dots or crosses. They could put each part on a part whole model too. 	4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 

Counting on using number lines using cubes or Numicon.



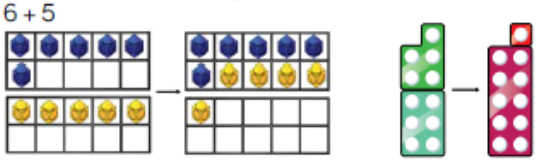


A bar model which encourages the children to count on, rather than count all.

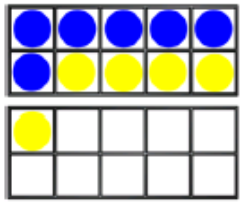


The abstract number line:
What is 2 more than 4?
What is the sum of 2 and 4?
What is the total of 4 and 2?
4 + 2

Regrouping to make 10; using ten frames and counters/cubes or using Numicon.
6 + 5



Children to draw the ten frame and counters/cubes.



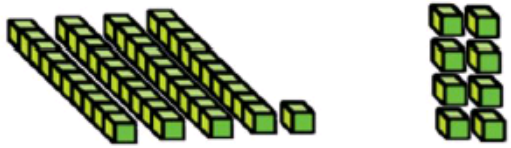
Children to develop an understanding of equality e.g.

$6 + \square = 11$

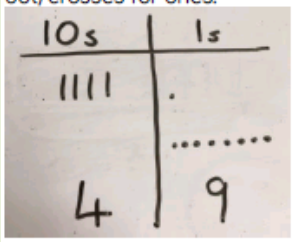
$6 + 5 = 5 + \square$

$6 + 5 = \square + 4$

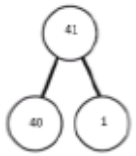
TO + O using base 10. Continue to develop understanding of partitioning and place value.
41 + 8



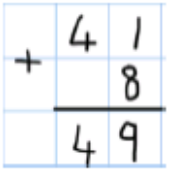
Children to represent the base 10 e.g. lines for tens and dot/crosses for ones.



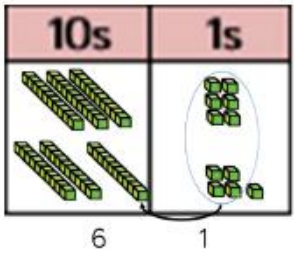
41 + 8



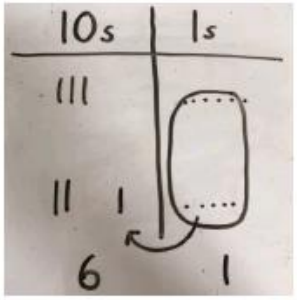
1 + 8 = 9
40 + 9 = 49



TO + TO using base 10. Continue to develop understanding of partitioning and place value.
36 + 25



Chidlren to represent the base 10 in a place value chart.



Looking for ways to make 10.

36 + 25=

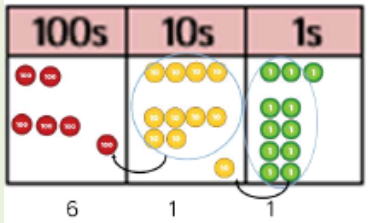
1 5

30 + 20 = 50
5 + 5 = 10
50 + 10 + 1 = 61

Formal method:

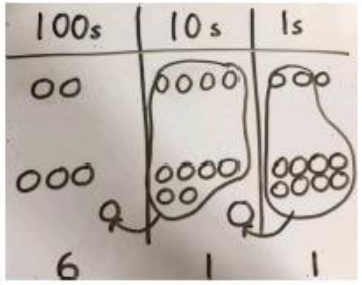
$$\begin{array}{r} 36 \\ +25 \\ \hline 61 \\ \hline 1 \end{array}$$

Use of place value counters to add HTO + TO, HTO + HTO etc. When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.



Children may also use deines and exchange when 10 or more. Chn should start with the ones.

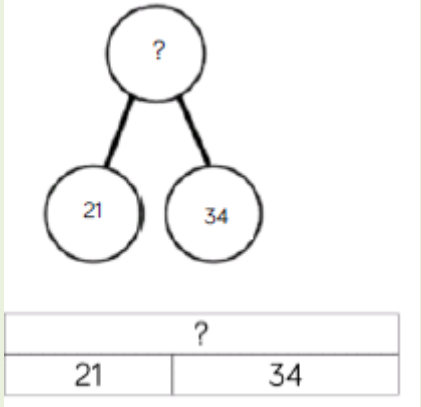
Chidren to represent the counters in a place value chart, circling when they make an exchange.



Children may not spend long here before moving to the abstract. Chn could always use deines alongside the abstract method

$$\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 1\ 1 \end{array}$$

Conceptual Variation – different ways to ask children to solve 21 + 34



Word problems:
In year 3, there are 21 children and in year 4, there are 34 children.
How many children in total?

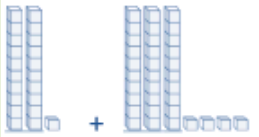
21 + 34 = 55. Prove it

$$\begin{array}{r} 21 \\ +34 \\ \hline \end{array}$$

21 + 34 =

$\square$ = 21 + 34

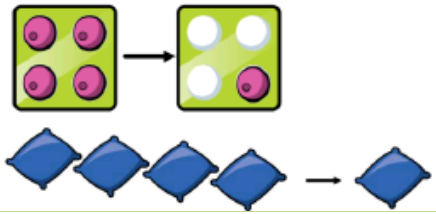
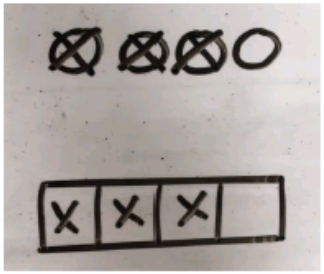
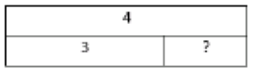
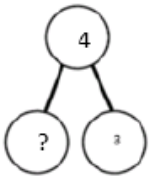
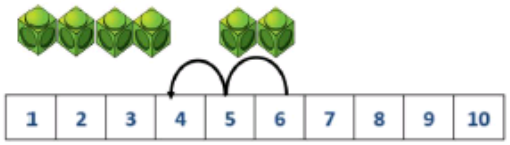
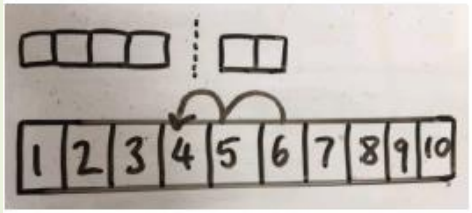
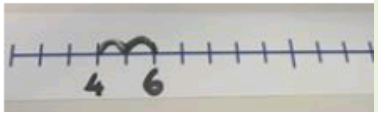
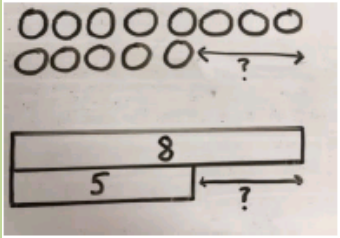
Calculate the sum of twenty-one and thirty-four.



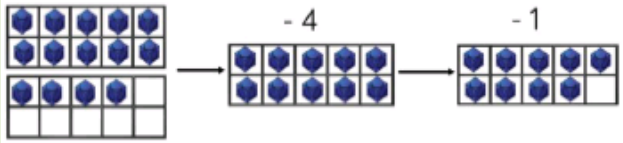
Missing digit problems:

10s	1s
10 10	1
10 10 10	?
?	5

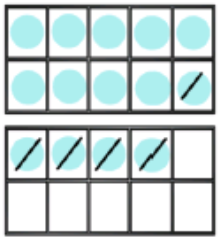
Subtraction -

C	P	A
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 – 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	4- 3 = □ = 4 – 3  
Counting back (using number lines or number tracks) children start with 6 and count back 2. 6 – 2 = 4  	Children to represent what they see pictorially e.g.  	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  
Finding the difference (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5.  	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate.  	Find the difference between 8 and 5. 8 – 5, the difference is □ Children to explore why 9 - 6 = 8 – 5 = 7 – 4 have the same difference.

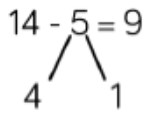
Making 10 using ten frames.
14 – 5



Children to present the ten frame pictorially and discuss what they did to make 10.

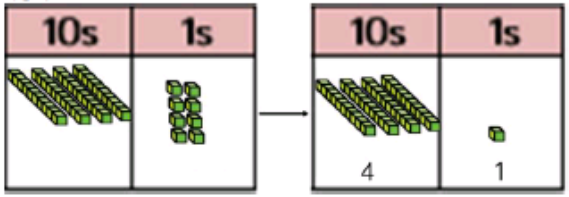


Children to show how they can make 10 by partitioning the subtrahend.

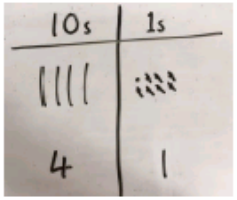


14 – 4 = 10
10 – 1 = 9

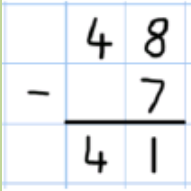
Column method using base 10.
48-7



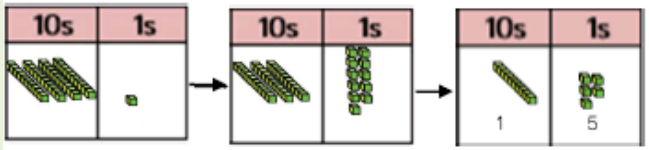
Children to represent the base 10 pictorially.



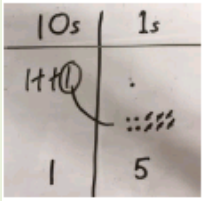
Column method or children could count back 7.



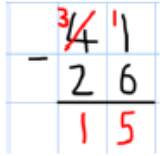
Column method using base 10 and having to exchange.
41 – 26



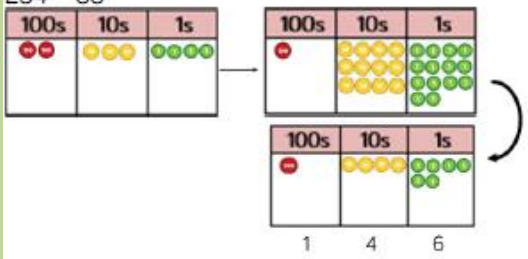
Represent the base 10 pictorially, remembering to show the exchange.



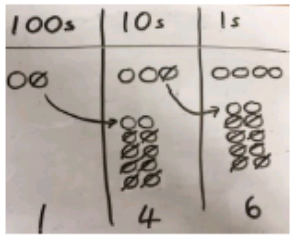
Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because 41 = 30 + 11.



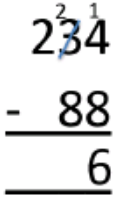
Column method using place value counters.
234 – 88



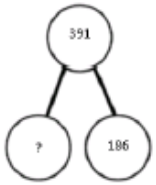
Represent the place value counters pictorially; remembering to show what has been exchanged.



Formal colum method. Children must understand what has happened when they have crossed out digits.



Conceptual Variation – different ways to ask children to solve 391 - 186



391	
186	?

Raj spent £391, Timmy spent £186.
How much more did Raj spend?

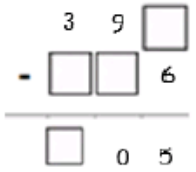
Calculate the difference between 391 and 186.

□ = 391 – 186

391
-186
___

What is 186 less than 391?

Missing digit calculations

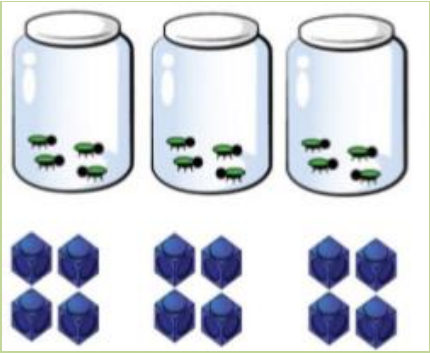
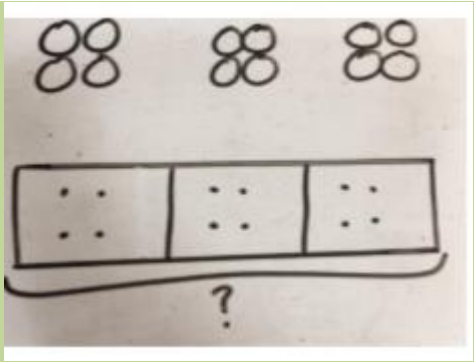
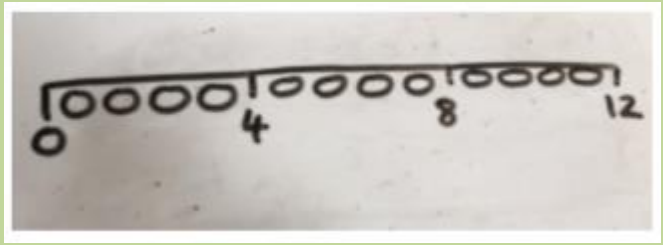
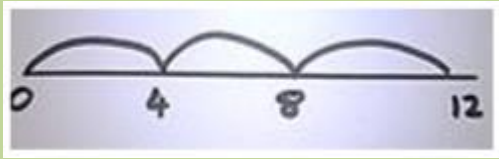
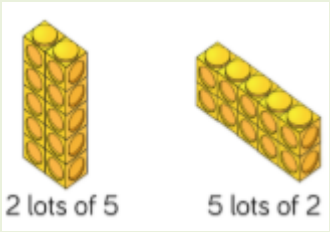
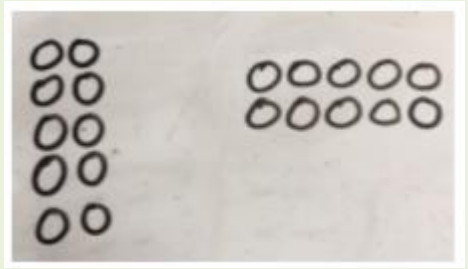


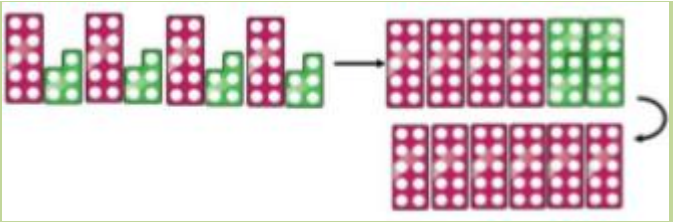
Year Group Guidance

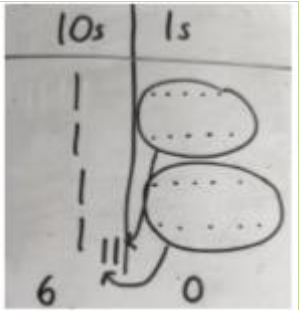
ADDITION

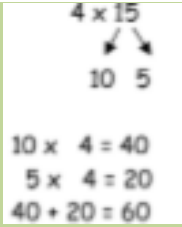
EYFS/Y1	Y2	Y3	Y4	Y5	Y6
Combining two parts to make a whole: part whole model. Starting at the bigger number and counting on- using cubes. Regrouping to make 10 using ten frame. Regrouping / partitioning to make numbers to 10 (2, 3, 4, 5, 6, 7, 8, 9) – Numicon, cubes, counters etc..	Adding three single digits. Use of base 10 to combine two numbers, *including pictorial representations of this.* Regrouping / Bridging *using knowledge of numberbonds within 10.* *E.g. 17 + 8 =* *17 + 3 (20) + 5 = 25* *Column method- regrouping – if secure knowledge on number / place value and of*	Column method- regrouping. *Bridging using knowledge of numberbonds within 10.* *E.g. 17 + 8 =* *17 + 3 (20) + 5 = 25* Using place value counters and deines (up to 3 digits), including pictorial representations of this.	Column method- regrouping. (up to 4 digits)	Column method- regrouping. Use of place value counters for adding decimals.	Column method- regrouping. Abstract methods. Place value counters to be used for adding decimal numbers.

	previous methods.				
SUBTRACTION					
EYFS/Y1	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Taking away ones Counting back Find the difference Make 10 using the ten frame Present problems in Part whole model & Bar Model	Counting back Find the difference Part whole model & Bar Model Make 10 (bridging backwards) Use of base 10 Column method with regrouping - *if secure knowledge after base 10 method*	Column method with regrouping. (up to 3 digits using place value counters) Present problems using Part whole model & Bar Model	Column method with regrouping. (up to 4 digits) Present problems using Part whole model & Bar Model	Column method with regrouping. Abstract for whole numbers. Start with place value counters for decimals- with the same amount of decimal places.	Column method with regrouping. Abstract methods. *Can use* Place value counters for decimals- with different amounts of decimal places. Calculation
Multiplication					
C		**P**		**A**	
Repeated grouping/repeated addition 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group.		Children to represent the practical resources in a picture and use a bar model.		3 X 4 = 12 4 + 4 + 4 = 12	

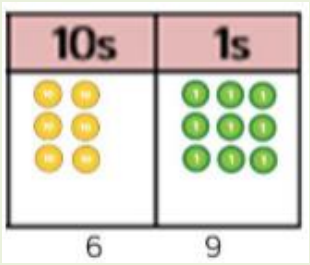
 **Number lines to show repeated groups –** 3 x 4  Cuisenaire rods can be used too.	 Represent this pictorially alongside a number line. E.g. 	Abstract number line showing three jumps of four. 3 x 4 = 12 
Use arrays to illustrate commutativity counters and other objects can be used. 2 x 5 = 5 x 2  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially. 	Children to be able to use an array to write a range of calculations. E.G. 10 = 2 x 5 5 x 2 = 10 2 + 2 + 2 + 2 + 2 = 10 10 = 5 + 5
Partition to multiply using Numicon, base 10 or Cuisenaire rods. 4 × 15	Children to represent the concrete manipulatives pictorially	Children to be encouraged to show the steps they have taken.



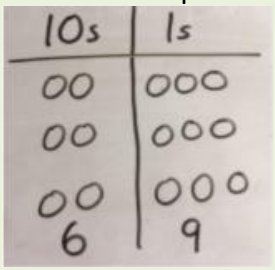




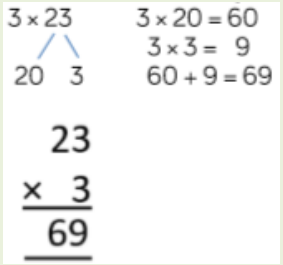
Formal column method with place value counters (base 10 can also be used.) 3 × 23



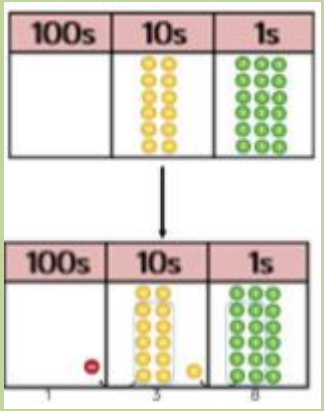
Children to represent the counters pictorially.



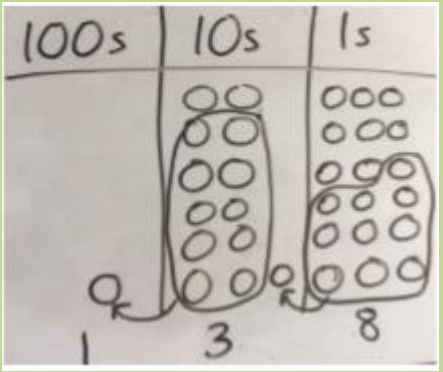
Children to record what it is they are doing to show understanding.



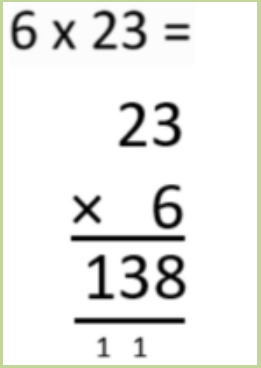
Formal column method with place value counters.
6 x 23

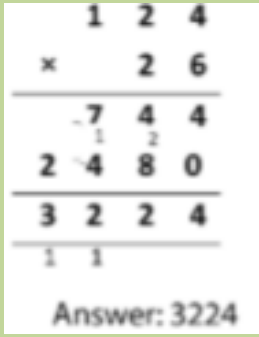


Children to represent the counters/base 10, pictorially e.g. the image below.

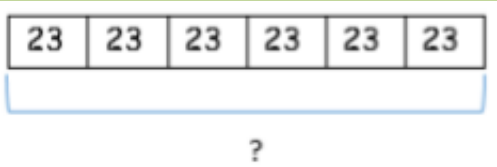


Formal written method





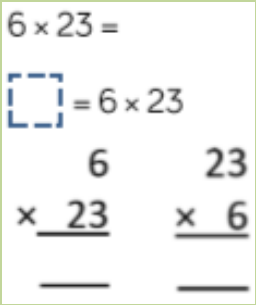
Conceptual variation; different ways to ask children to solve 6 × 23



Mai had to swim 23 lengths, 6 times a week. How many lengths did she swim in one week?

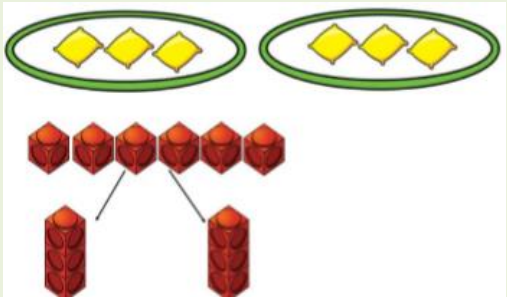
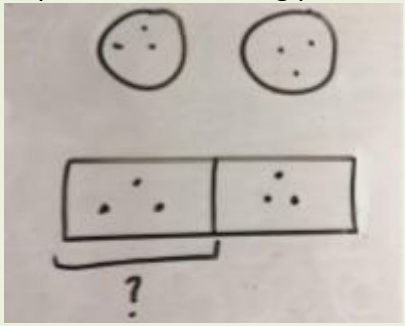
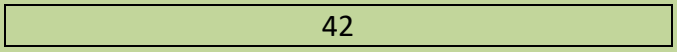
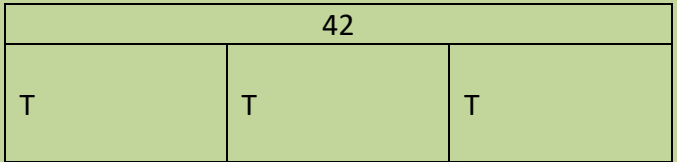
With the counters, prove that 6 x 23 = 138

Find the product of 6 and 23.

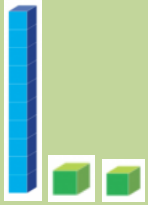


What is the calculation?
What is the product?

DIVISION

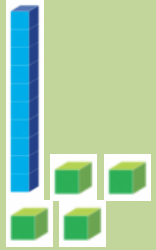
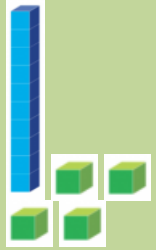
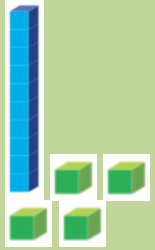
C	P	A
Sharing using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 	6 ÷ 2 = 3 Bar Model:  Children should also be encouraged to use their 2 times tables facts.
Short Division / Sharing using place value counters or deines. 42 ÷ 3 = 14 	Ch to replace deines with T & ones 	Bus stop method: Use pictorial approach alongside bus stop when introducing to explain why numbers are carried across – because we are exchanging.



Can't put last T in a column – otherwise 1 column would have more Ts than the others.

So, exchange the T for 10 ones. Added to the 2 existing ones, there are now 12 ones. Share these out, making sure all columns have the same.

42		
		

= 14

1 1 1 1	1 1 1 1	1 1 1 1

T + 2 = 12

Encourage children to use their x tables when dividing – particularly left over ones.
E.G.
12 ÷ 3 = 4

Children can then just write 4 in each column instead of the ones.

42		
T 4	T 4	T 4

$$5\overline{)615} = 123$$

Long Multiplication:
-Chunking Method

Also look into:

We can't group 2 thousands into groups of 12 so will exchange them.

We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

$$12\overline{)2544} = 02 \text{ r } 1$$

After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens.

$$12\overline{)2544} = 021 \text{ r } 2$$

After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

$$12\overline{)2544} = 0212 \text{ r } 0$$

				Children should also be taught to spot factors of numbers to divide enabling short division/bus stop to be used. E.g. 2544 ÷ 24 = 2544 ÷ 6 ÷ 4 2 short bus stops can be used this way.	
Multiplication					
EYFS/Y1	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Recognising and making equal groups. Doubling Counting in multiples Use cubes, Numicon and other objects in the classroom	Arrays- showing commutative multiplication Arrays	Arrays 2d × 1d using base 10 Column multiplication- introduced with place value counters. (before removing and using column in abstract way)	Column multiplication- Children will initially need to recap Y3 place value counters before moving to abstract only. (2 and 3 digit multiplied by 1 digit	Column multiplication Abstract only, but some children might need a repeat of year 3 first (up to 4 digit numbers multiplied by 1 or 2 digits)	Column multiplication Abstract methods (multi-digit up to 4 digits by a 2 digit number)
Division					
EYFS/Y1	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Sharing objects into groups	Division as grouping Division within arrays-	2d divided by 1d using base 10 / deines, or place value counters –	Division with a remainder Short division (up to 3	Short division (up to 4 digits by a 1	Short division Long division –

Division as grouping e.g. I have 12 sweets and put them in groups of 3, how many groups? Use cubes and draw round 3 cubes at a time.	linking to multiplication Repeated subtraction Short Division using Deines / Pictorial method (q's such as 90 ÷ 2)	before moving to pictorial approach. Some examples to have remainders. Using x table facts. Ch can move to bus stop if secure with understanding behind deines/pictorial method.	digits by 1 digit- concrete and pictorial)	digit number including remainders)	chunking method (up to 4 digits by a 2 digit number) Children should exchange into the tenths and hundredths column too

Y1/2:

New Vocabulary:

Y1:

Place Value:	**Addition & Subtraction**
Number Zero, one, two, three to twenty, and beyond None Count (on/up/to/from/ down) Before, after More, less, many, few, fewer, least, fewest, smallest, greater, lesser Equal to, the same as Odd, even Pair Units, ones, tens Ten more/less Digit Numeral Figure(s) Compare (In) order/a different order	Number bonds, number line Add, more, plus, make, sum, total, altogether Inverse Double, near double Half, halve Equals, is the same as (including equals sign) Difference between How many more to make..?, how many more is … than …? how much more is..? Subtract, take away, minus How many fewer is…than..?, how much less is..?

Non-negotiables:

Counting on/back in 1s/10s to 100 (starting at different numbers) (**Y2** consolidate)
Counting in 2s, 5s and 10s (**Y1**). Extend to 20s 50s and 100s where appropriate (**Y2**).
Number bonds to 10 (**Y1**) & 20 (**Y2**) (Extend to 100 – multiples of 5)
Rapid recall of number bonds of numbers within 10 (2, 3, 4, 5, 6, 7, 8, 9) (**Y1**) – extend to numbers between 10 & 20. (**Y2**)
Counting forwards and backwards using appropriate times tables and extending to multiples of 10 (**Y1**/**2**)
Teach 'biggest number first/in head' (**Y1**)
Rapid recall of 2, 5, 10 x tables (less than 5 secs). Extend to 3x & 4x tables when secure. (**Y2**)
Recall of doubles to 10 (**Y1**) & 20 (**Y2**) (eg 18 + 18) and their corresponding halves. Extend to near doubles & halves (**Y2**).
Relate to fractions for known times tables eg: 2s, 5s and 10s (3s and 4s when secure) (**Y2**).
Commutative principle: 3+5=5+3 (**Y1**) & 3x5=5x3 (**Y2**)(not true for division & subtraction)

Size Value Between, halfway between Above, below	
Multiplication & Division:	**Fractions:**
Odd, even Count in twos, threes, fives Count in tens (forwards from/backwards from) How many times? Lots of, groups of Once, twice, three times, five times Multiple of, times, multiply, multiply by Repeated addition Array, row, column Double, halve Share, share equally Group in pairs, threes, etc. Equal groups of Divide, divided by, left, left over	Whole Equal parts, four equal parts One half, two halves A quarter, two quarters

Y2:

Fractions:	**Number & PV:**	**Fractions:**
Three quarters, one third, a third Equivalence, equivalent	Numbers to one hundred Hundreds Partition, recombine Hundred more/less	Three quarters, one third, a third Equivalence, equivalent Numerator Denominator

Y3/4

New Vocabulary:

Y3:

Number & PV	Addition & Subtraction	Multiplication & Division	Fractions
Numbers to one thousand	**Column addition and subtraction**	**Product Multiples of four, eight, fifty and one hundred Scale up**	**Unit fraction, nonunit fraction Compare and order Tenths**

Y4:

Number & PV	Multiplication & Division	Fractions

Non-negotiables:

Number bonds to 100 (extend & apply to 1000)

Continue to consolidate and apply place value and number bonds to decimals/larger numbers

Number bonds for decimals/money

Y3

Consolidation of recall of doubles to 20 (eg 18 + 18) and their corresponding halves

To use near doubles and halves to 20 to support mental calculation

To be able to quickly half multiples of 10 (including odd multiples)

Counting forwards and backwards in appropriate times tables and extending to multiples of 10/100 plus decimals including tenths

Mental strategies for finding the difference. (count on / bridging)

Rapid recall of 2, 5, 10, 3, 4, 8 x tables up to 12x by end of Y3. Extending to 6x x/÷ 10 explore patterns

Rapid recall of number bonds to 100

Y4:

Tenths, hundredths **Decimal (places)** **Round (to nearest)** **Thousand more/less than** **Negative integers** **Count through zero** **Roman numerals (I to C)**	**Multiplication facts (up to 12x12)** **Division facts** **Inverse** **Derive**	**Equivalent decimals and fractions**	

Rapid recall of times tables up to 12x12 by end of Y4
Consolidate rapid recall of number bonds to 100 (link to money)
Counting in appropriate times tables and extending to multiples of 10/100/1000 plus decimals including tenths and hundredths.
Use double and halving to make multiplications simpler. E.g. 16 x 4 = 8 x 8
x/÷ 10/100 – extend to 1000 - linked to units of measure
Doubles to 50 and their corresponding halves.
To be able to find halves and quarters of even numbers to 100 using mental strategies (quarters with whole numbers as answers)
To know equivalent fractions and decimals for halves and quarters (extending to fifths)

Y5/6: Key skills & Vocab

New Vocabulary
Y5:

Number & PV	**Addition & Subtraction**	**Multiplication & Division**	**Fractions, Decimals & Percentages**

Non-negotiables:

Y5:
Consolidate rapid recall of all times tables up to 12x12
Use related multiplication facts to support with mental multiplying and dividing. E.g. 2700 / 9 = 300
Consolidate number bonds, including decimals (0.45 + 0.55 = 1) and extend to decimals & larger numbers (thousands)
Consolidate use of doubling and halving to make multiplications simpler. E.g. 16 x 4 = 8 x 8.
Consolidate x/÷ 10/100/1000 – link to measures.
Consolidate doubles to 50 & corresponding halves and extend to 100
Consolidate quickly finding halves and quarters of even numbers to 100 using mental strategies (quarters with whole numbers as answers)
To know equivalent fractions and decimals for halves, quarters & fifths by heart.

Powers of 10	Efficient written method	Factor pairs Composite numbers, prime number, prime factors, square number, cubed number Formal written method	Proper fractions, improper fractions, mixed numbers Percentage Half, quarter, fifth, two fifths, four fifths Ratio, proportion

Y6:

Number & PV	**Addition & Subtraction**	**Multiplication & Division**	**Fractions, Decimals & Percentages**
Numbers to ten million	Order of operations	Order of operations Common factors, common multiples	Degree of accuracy Simplify

To be able to use mental strategies to find halves, quarters and eighths of numbers (E.g. quarter by halving & halving again)

Y6:
Doubles to 100 and corresponding halves.
To quickly find half or a quarter of any number to 100 (including decimals (half of 97 = 48.5)
To be able to mentally calculate 25% 50% 10% 5% of multiples of 10.
To know equivalent fraction, decimal, percentages for halves, quarters, fifths, thirds, eighths.
To know rules such as 7 + 8 + 9 = 8 x 3
To know patterns for multiplication tables to be able to quickly check divisibility of large numbers (E.g. when adding the digits of all multiples of nines, they add up to 9, or 18 which adds to 9 or 27 which adds to 9 etc..)