BROCKSWOOD PRIMARY
& NURSERY SCHOOL
LEARNING TOGETHER - ACHIEVING TOGETHER

Calculation Policy: Addition and Subtraction

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1. Rationale

This policy outlines a model progression through written strategies for addition, subtraction, multiplication and division in line with the National Curriculum that commenced in September 2014. Through the policy, we aim to link key manipulatives and representations in order that the children can be vertically accelerated through each strand of calculation. Our policy reflects movement between concrete, pictorial and abstract notation in each phase. We know that school wide policies, such as this, can ensure consistency of approach, enabling children to progress stage by stage through models and representations they recognise from previous teaching, allowing for deeper conceptual understanding and fluency. As children move at the pace appropriate to them, teachers will be presenting strategies and equipment appropriate to children's level of understanding.

Early practical, oral and mental work *must lay the foundations* by providing children with a good understanding of:-

- How the four operations build on efficient counting strategies
- Place value
- Number facts

Children have an early exposure to the representation of the rectangular bar model as a means of representation for all operations; this notation is then followed through in subsequent phases.

The importance of mental mathematics

While this policy focuses on written calculations in mathematics, we recognise the importance of the mental strategies and known facts that form the basis of all calculations. The following checklists outline the key skills and number facts that children are expected to develop throughout the school.

To add and subtract successfully, children should be able to:

- recall all addition pairs to 9 + 9
- number bonds to 10, then apply these to number bonds beyond 10
- recognise addition and subtraction as inverse operations
- add mentally a series of one digit numbers (e.g. 5 + 8 + 4)
- add and subtract multiples of 10 or 100 using the related addition fact and their knowledge of place value (e.g. 600 + 700, 160 — 70)
- partition 2 and 3 digit numbers into multiples of 100, 10 and 1 in different ways (e.g. partition 74 into 70 + 4 or 60 + 14)
- use estimation by rounding to check answers are reasonable

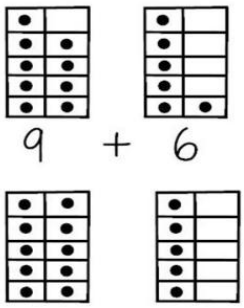
To multiply and divide successfully, children should be able to:

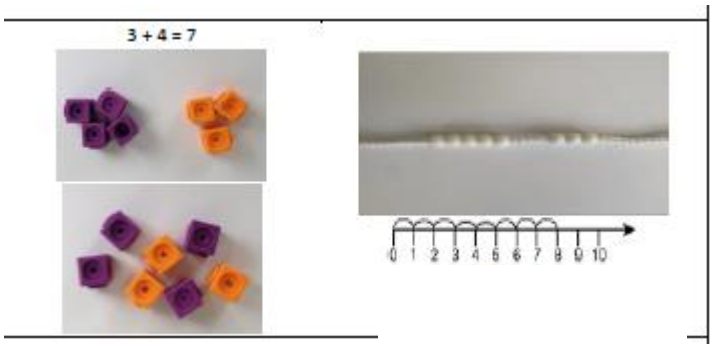
- add and subtract accurately and efficiently
- recall multiplication facts to 12 x 12 = 144 and division facts to 144 ÷ 12 = 12
- use multiplication and division facts to estimate how many times one number divides into another etc.
- know the outcome of multiplying by 0 and by 1 and of dividing by 1
- understand the effect of multiplying and dividing whole numbers by 10, 100 and later 1000
- recognise factor pairs of numbers (e.g. that 15 = 3 x 5/ 5 x 3, or that 40 = 10 x 4) and increasingly able to recognise common factors
- derive other results from multiplication and division facts and multiplication and division by 10 or 100 (and later 1000)
- notice and recall with increasing fluency inverse facts
- partition numbers into 100s, 10s and 1s or multiple groupings
- understand how the principles of commutative, associative and distributive laws apply or do not apply to multiplication and division
- understand the effects of scaling by whole numbers and decimal numbers or fractions
- understand correspondence where n objects are related to m objects
- investigate and learn rules for divisibility

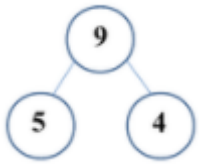
2. ADDITION: Phase 1: Strategies

2.1 Combining two sets (aggregation)

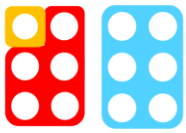
- Joining two groups and then recounting all objects using one-to-one correspondence
- Language of **altogether and total, add together**
- Range of practical experiences e.g. counters, plastic animals, cubes, bead strings, Cuisenaire rods, number lines, tens frames, numicon, numberblocks
- Introduce idea of proportionality of numbers being used through use of Numicon/ Numberblocks and making comparisons, multilink, tens frames and subsequent rectangular bar.

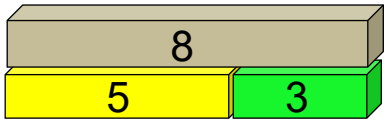


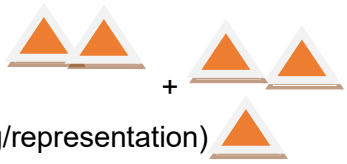




5+1=6





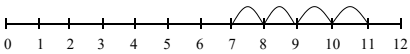


(children's own drawing/representation)

2.2 Number lines

- Counting on number line using physical actions, eg. Number track on playground and jumping
- Counting on using a number line (numbered line)

7 + 4



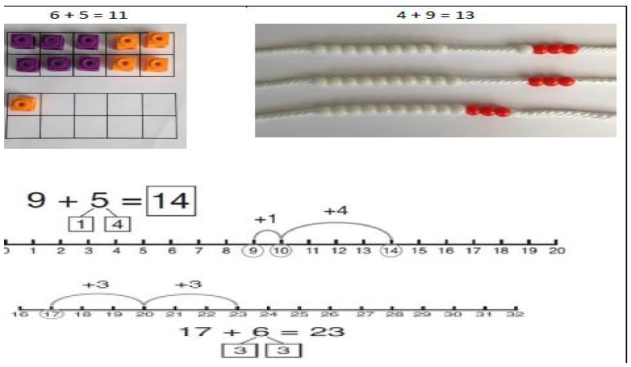
- **Leading to counting mentally**, keeping the largest number in your head.
- Recording by - drawing jumps on prepared and then constructing own lines
- Children could be introduced to counting on using the hundreds square

2.3 Bridging through 10

- This stage encourages children to become more efficient and begin to employ known facts
- Pupils should be encouraged to start at the bigger number and use the smaller number to make ten.
- The colours of the beads on the bead string make it clear how many more need to be added to make ten.

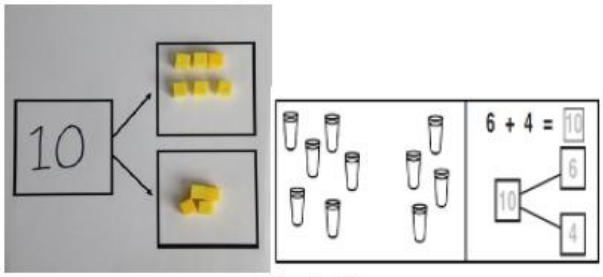
7 + 5 is decomposed / partitioned into 7 + 3 + 2.

The bead string illustrates ‘how many more to the next multiple of 10?’ (children should identify how their number bonds are being applied) and then ‘if we have used 3 of the 5 to get to 10, how many more do we need to add on? (ability to decompose/partition all numbers applied)

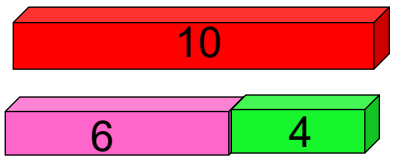


2.4 Part- Part Whole

- This model identifies the inverse link between addition and subtraction
- It develops understanding of the commutativity of addition as the ‘parts’ can make the ‘whole’ in any order.
- It links to the Part-Part Whole model of the rectangular bar.
- This can be used to reinforce number bonds to 10 and 20.



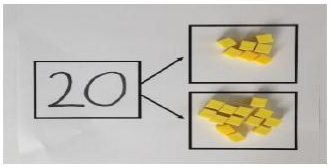
10 = 6 + 4
10 − 6 = 4
10 − 4 = 6
10 = 4 + 6

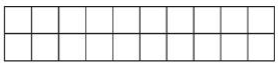


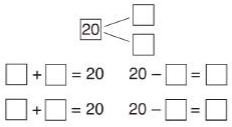
3. ADDITION: Phase 2: Strategies

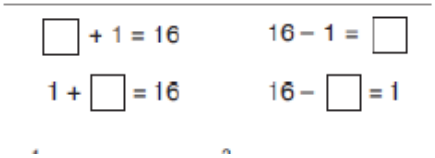
3.1 Part-Part Whole

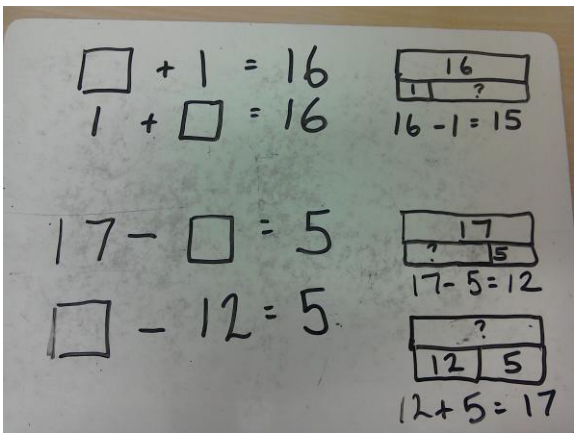
- Pupils explore the different ways of making 20. They can do this with all numbers using the same representation.
- This model continues to develop knowledge of the inverse relationship between addition and subtraction that started in Phase 1 and is used to find the answer to missing number problems. This can again also be shown using the bar model.





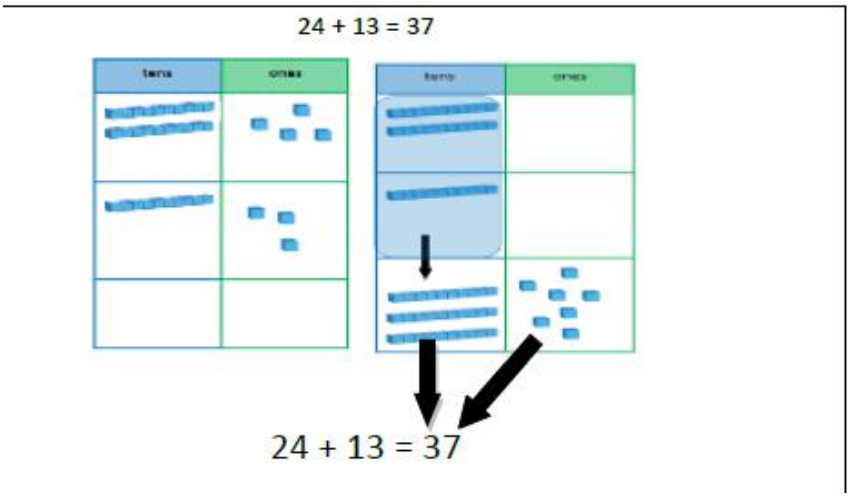






3.2 Partitioning

- Place value grids and base 10 blocks or place value counters should be used as shown in the diagram below before moving onto the pictorial representations.
- When not regrouping, partitioning is a **mental strategy** and does not need formal recording in columns. This representation prepares them for using column addition with formal recording



- Children can then move onto using blank numberlines to partition and adjust, before removing these when they are confident
- Children start by partitioning one number, then adding tens and ones.
- Children should draw a bar to show proportional represention of the numbers and ensure their answer makes sense.

Number lines

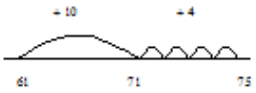
empty)

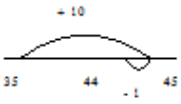
61 + 14

(partition)

35 + 9

add 9 by adjusting





Number lines

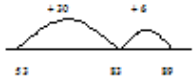
(numbered)

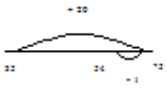
53 + 36

(partition)

35 + 19

add 19 by adjusting





Partition ~~second no.~~ and add

Informal jottings

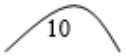
Partition into tens and ones and recombine

23 + 12 = 23 + 10 + 2

= 33 + 2

= 35

Partition the second number and add



3 + 8 + 7 = 10 + 8

10 + 8= 18

Pairs totalling ten

Other jottings

Partition into tens and ones and recombine

42 + 27 = 42 + 20 + 7

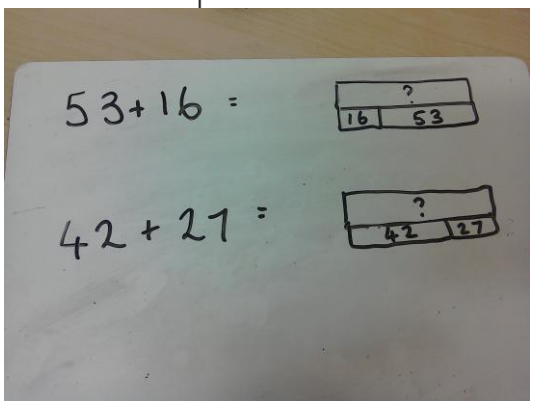
= 62 + 7

= 69

Pairs totalling ten or twenty

4 + 8 + 16 + 2 = 20 + 10

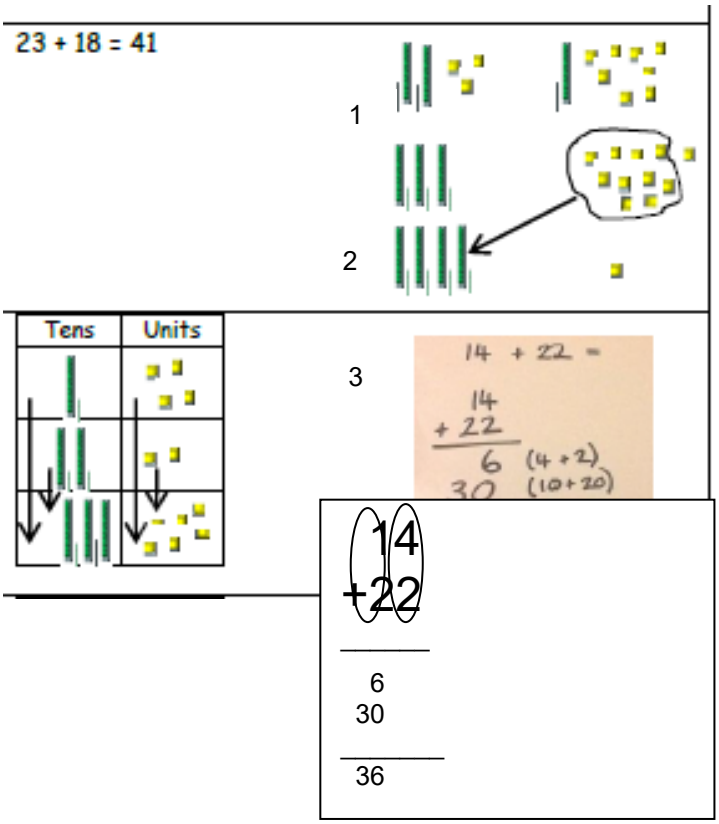
= 30

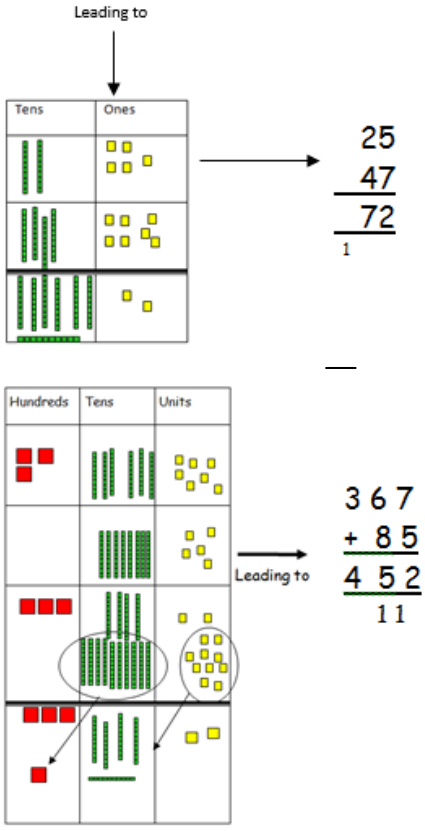


4. ADDITION: Phase 3: Strategies

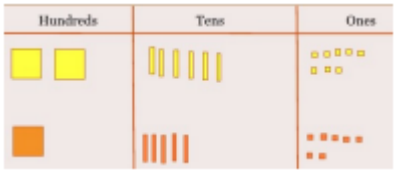
4.1 Expanded column addition

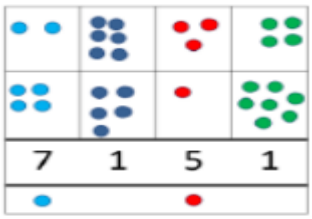
- Children begin to set out TO + TO (that cross the tens boundary) in columns and record as expanded column addition that will then lead to formal column addition.

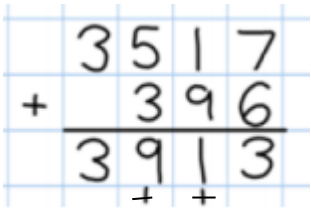




Children continue to use dienes or pv counters to add, exchanging ten ones for a ten and ten tens for a hundred and ten hundreds for a thousand.





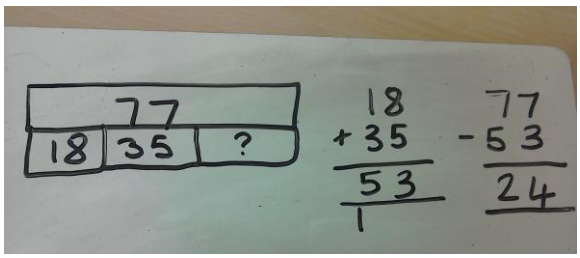


- Children continue to use the bar model to interpret and represent problem solving in order to use the correct written method. Often these require written methods of addition and subtraction. (See Subtraction section)

e.g. Seb has 77 cubes. He builds two towers. One tower uses 18 cubes and one tower uses 35 cubes. How many cubes does he have left over?

ADDITION

Phase 4: Strategies

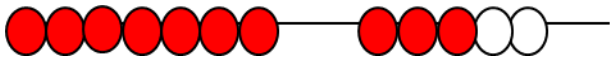


Formal Column Addition with decimals

$$\begin{array}{r} 47 \\ +\ 76 \\ \hline 123 \\ \hline 11 \end{array} \qquad \begin{array}{r} 258 \\ +\ 87 \\ \hline 345 \\ \hline 11 \end{array} \qquad \begin{array}{r} 366 \\ +458 \\ \hline 824 \\ \hline 11 \end{array}$$

- Column addition remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable. In this phase the standard method is expanded to include the use of decimals.

- Introduction of addition with decimals can be shown using the bead string and base ten equipment. This enables children to use practical resources they are familiar with. Again the rectangular bar model can be used alongside the concrete equipment.

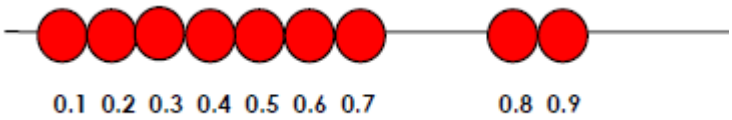


Each bead represents 0.1, each different block of colour equal to 1.0

Base 10 equipment:

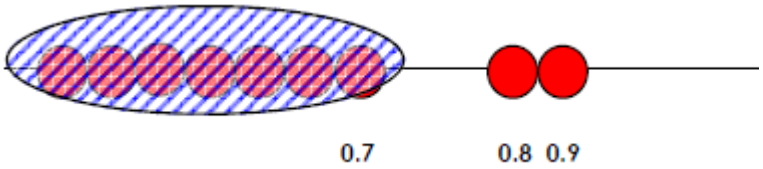
Counting both sets – starting at zero.

0.7 + 0.2 = 0.9



Starting from the first set total, count on to the end of the second set.

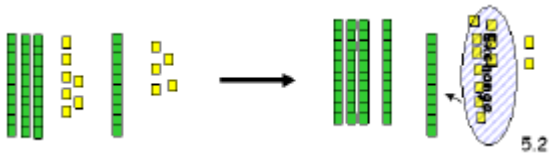
0.7 + 0.2 = 0.9



Encouraging connections with number bonds.

0.7 + 0.5 = 1.2

3.7 + 1.5 = 5.2

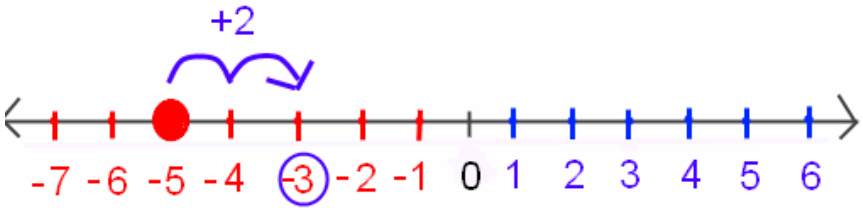


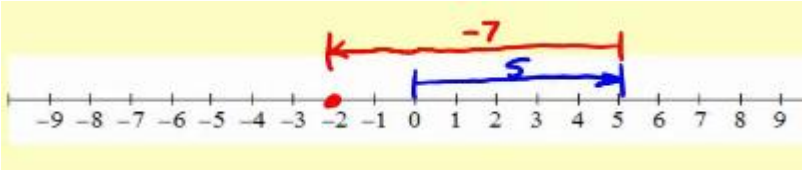
Using similar methods, children will:

- add several numbers with different numbers of digits;
- begin to add two or more three-digit sums of money, with or without adjustment from the pence to the pounds;
- know that the decimal points should line up under each other, particularly when adding or subtracting mixed amounts, e.g. £3.59 + 78p.

4.2 Number lines

- Number lines are used when counting and adding through zero.
- The use of the number line supports the use of direction for adding positive and negative numbers.
0



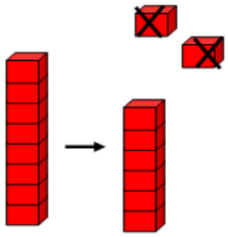


5. SUBTRACTION: Phase 1: Strategies

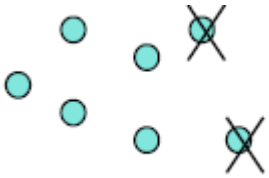
5.1 Taking away from the ones

- Use of concrete resources (cubes, Numicon, Numberblocks, counters, tens frames, topic related objects, pupils themselves etc.) to physically move items to embed the notion of taking away.
- The concrete representation should be based upon the diagram. Real objects should be placed on top of the images as one-to-one correspondence so that pupils can take them away, progressing to representing the group of ten with a tens rod and ones with ones cubes.
- Before representing as numerals, opportunities to represent as their own drawings.

Multilink towers - to physically take away objects.



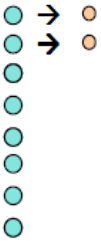
7 – 2 = 5

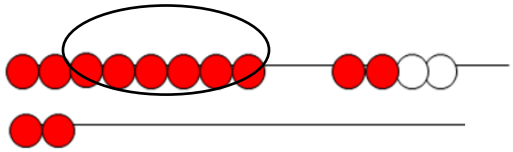


5.2 Finding the difference (comparison model)

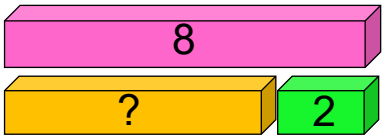
- Two quantities are compared to find the difference.
- This introduces language of **more than, less than, difference, greater than, fewer than.**

8 – 2 = 6



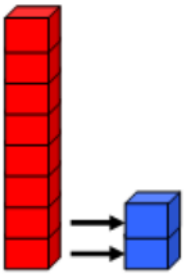


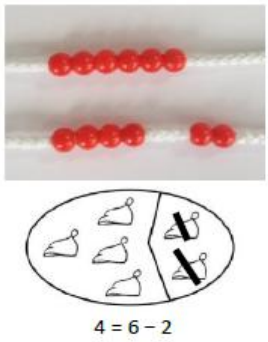
Make a set of 8 and a set of 2. Then count the gap.

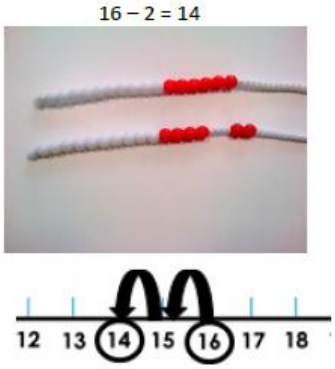


5.3 Counting back

- Introduce the idea of counting back through songs alongside exploring with manipulatives eg. 10 green bottles
- Subtracting 1, 2, or 3 etc by counting back,
- Pupils should be encouraged to rely on number bonds knowledge as time goes on, rather than using counting back as their main strategy.
- Number lines are used to represent counting back from largest number.
- Children will be taught how to solve simple subtraction stories with the support of a 100 number square.

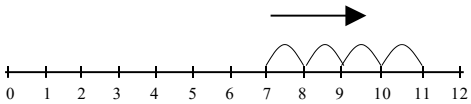






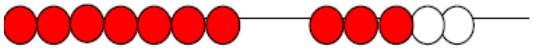
5.4 Counting on

- This relies on language of difference that was initiated in the comparison model. The **difference** between 7 and 11
- This is recorded by drawing jumps on prepared lines and constructing own lines

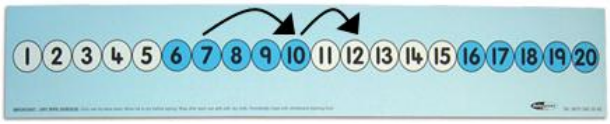


5.5 Nearest ten

- Starting from 7 on the bead string ‘how many more to the next multiple of 10?’ (children should recognise how their number bonds are being applied), ‘how many more to get to 12?’.



12 – 7 becomes 7 + 3 + 2.

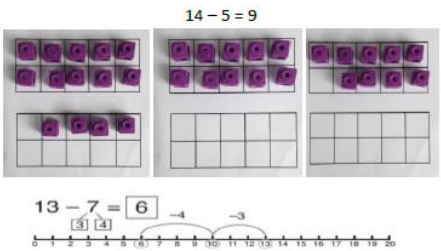
- Number Track: 

5.6 Part – Part Whole

- See Addition Phase 1 and Phase 2
- Continue to consolidate inverse link.

5.7 Make ten strategy

- This involves primarily taking a single digit number from a 2-digit number
- Pupils identify how many need to be taken away to make ten first. Then they take away the rest to reach the answer.

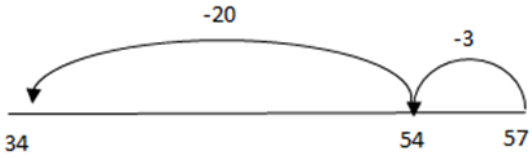


6. SUBTRACTION: Phase 2: Strategies

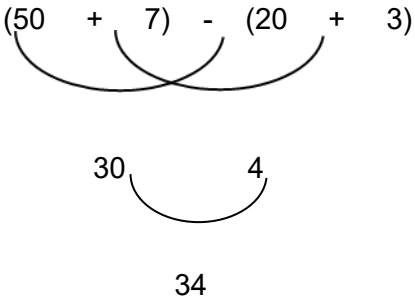
6.1 Take away (Separation model)

- Children remove the lower quantity from the larger set, starting with the ones and then the tens. In preparation for formal decomposition.
- Children begin to confidently use an empty number line to take away tens and ones.

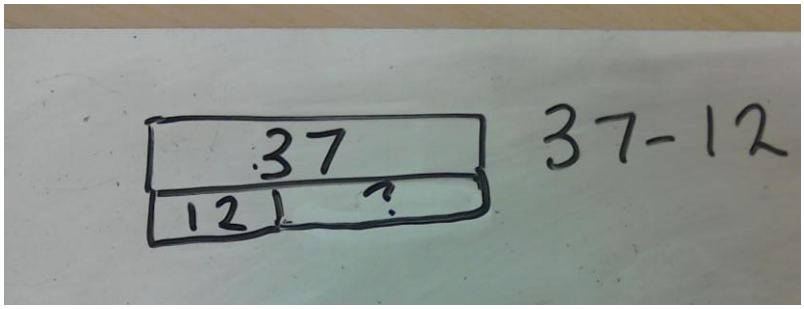
57 – 23 = 34



- At this stage, children can begin to use an informal method to support, record and explain their method (optional)

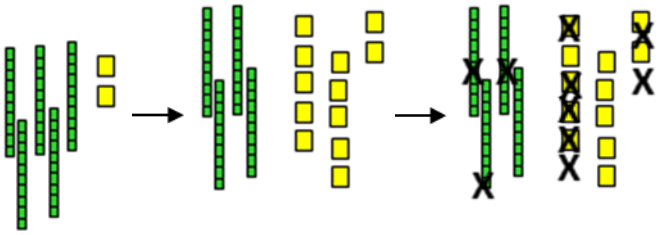


Informal jottings	**Informal jottings**
37 - 12 = 37 - 10 - 2 37 – 10 = 27 27 – 2 = 25	97 - 25 = 97 - 20 – 5 97 – 20 = 77 77 – 5

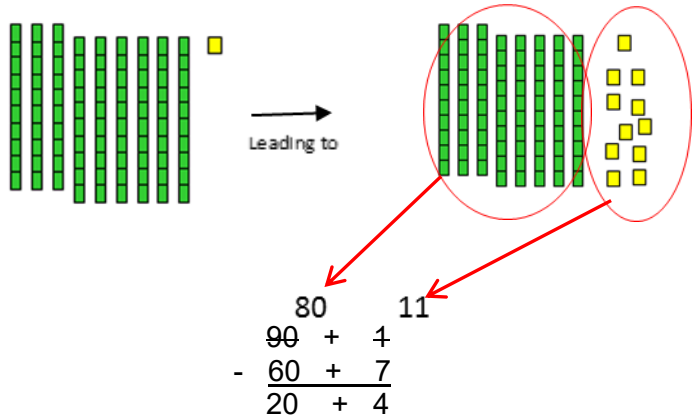


- Once secure in partitioning for addition, children begin to explore exchanging. What happens if the ones are greater than 10? Introduce the term ‘exchange’. Using the Base 10 equipment, children exchange tens for ten ones, which is equivalent to crossing the tens boundary on the bead string or number line.

52 – 37 = 15

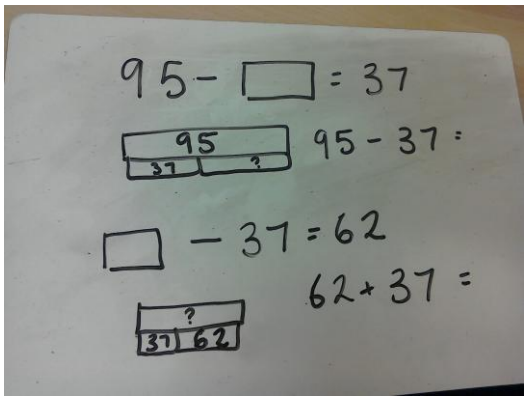


91 – 67 = 24



6.2 Part – Part Whole

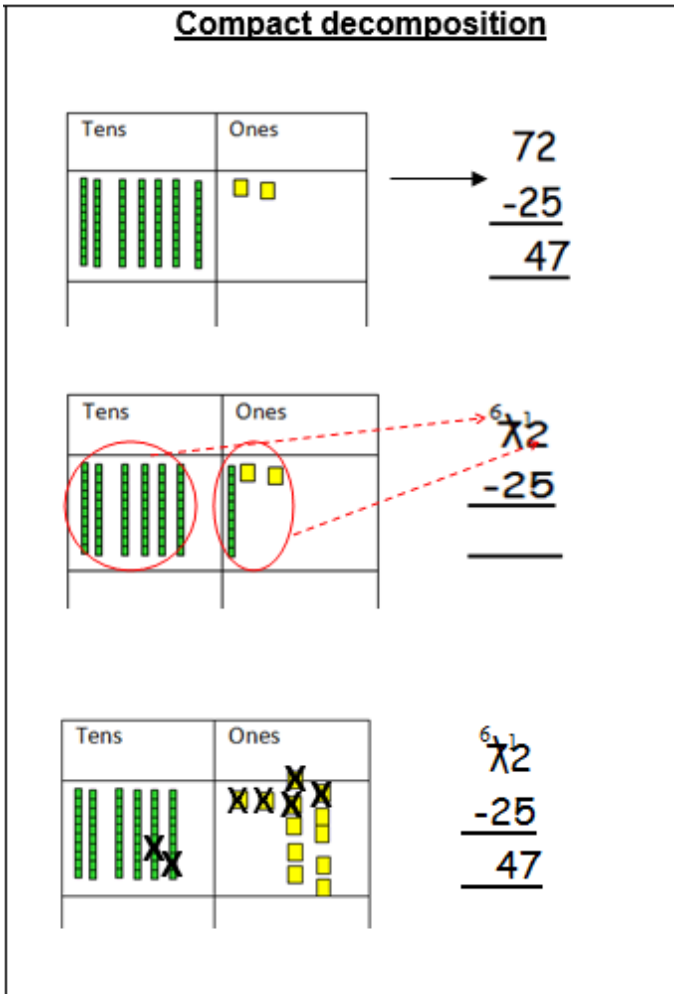
- Missing box number problems continue to consolidate use of the rectangular bar alongside the children choice of written method to solve.



7. SUBTRACTION: Phase 3: Strategies

7.1 Compact decomposition

- Once children have been introduced to the expanded vertical method, they can then make links with the formal written method for column subtraction.
- This can be again represented with the bar model alongside to revisit the part-part whole analogy.



8. SUBTRACTION: Phase 4: Strategies

- Column subtraction remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable. In this phase the standard method is expanded to include the use of decimals.
- Introduction of subtraction with decimals can be shown using the bead string and base ten equipment. This enables children to use practical resources they are familiar with. Again the rectangular bar model can be used alongside the concrete equipment.
- Children can then build towards using the formal written column method, including representation with manipulatives first.

Children should:

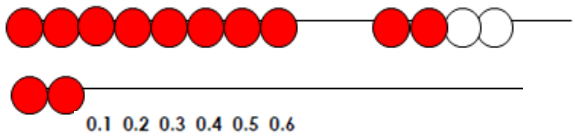
- be able to subtract numbers with different numbers of digits;
- be able to subtract two or more decimal fractions with up to three digits and either one or two decimal places; know that decimal points should line up under each other.

8.1 Take away model

0.9 – 0.2 = 0.7

8.2 Finding the difference (or comparison model):

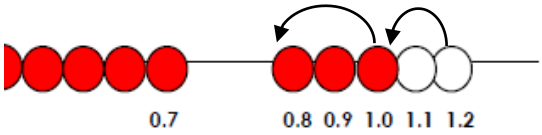
0.8 – 0.2 =



8.3 Bridging through 1.0

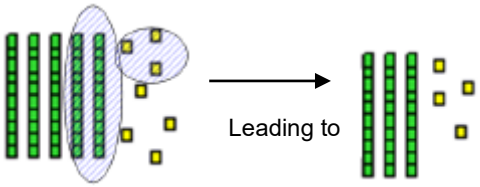
Encourage efficient partitioning.

1.2 – 0.5 = 1.2 – 0.2 – 0.3 = 0.7



8.4 Partitioning

5.7 – 2.3 = 3.4

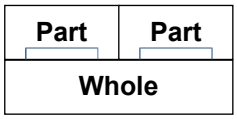


8.5 Column Subtraction

$$\begin{array}{r} 76.3 \\ -\ 34.1 \\ \hline 42.2 \end{array} \qquad \begin{array}{r} 4.321 \\ -\ 4.100 \\ \hline 0.221 \end{array}$$

9. ADDITION AND SUBTRACTION: Word Problems

Throughout the calculation policy for addition and subtraction, the continual reinforcement is their interconnectedness.

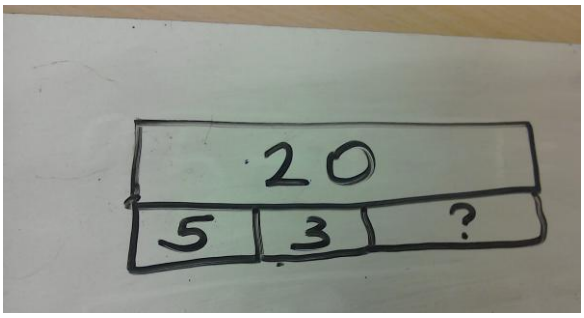


Addition names the whole in terms of the parts and **subtraction** names a missing part of the whole.

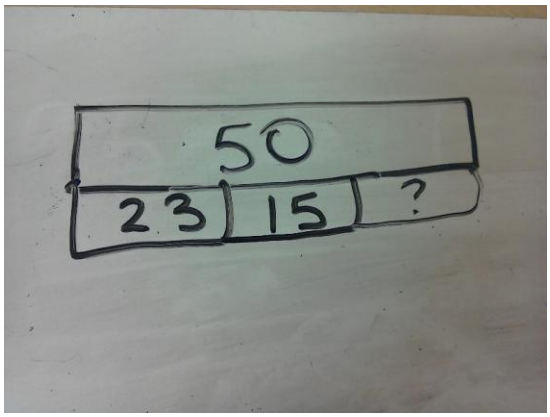
Below are examples of how, once secure, the bar model can be used as a means of representation for word problems, before the use of the written method of choice. As progress continues into Upper key stage 2, problem solving becomes more complicated and consistent use of the Bar Model in Phases 1 and 2 allows children to represent problems pictorially, whilst freeing up mental space for them to choose the correct written method. Questioning throughout the phases needs to focus on the Part-Part Whole structure – what is the whole? What are the parts? What do I know? What do I need to know?

9.1 Phase 1 and 2: Problem Types

Sam is collecting cards. He wants to collect 20 cards altogether. Last week he collected 5 cards. This week he collects 3 cards. How many more cards does he need?



Sita has 50 raisins. She gives 23 to Ben. She gives 15 to Amy. How many raisins does Sita have left?

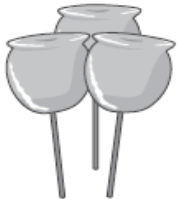


10. Phase 3 and 4: Problem Types

10.1 Year 3

Kirsty, Seb and Mina made toffee apples to sell at the school fair.

They made **80** toffee apples altogether.

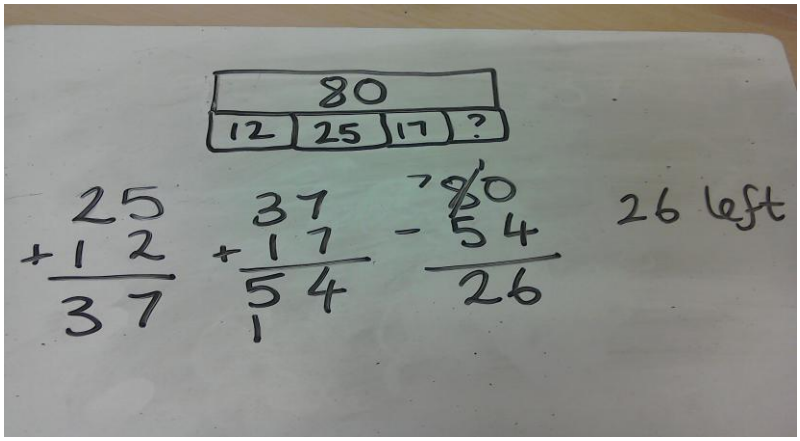


Kirsty sold **12** toffee apples.

Seb sold **25** toffee apples.

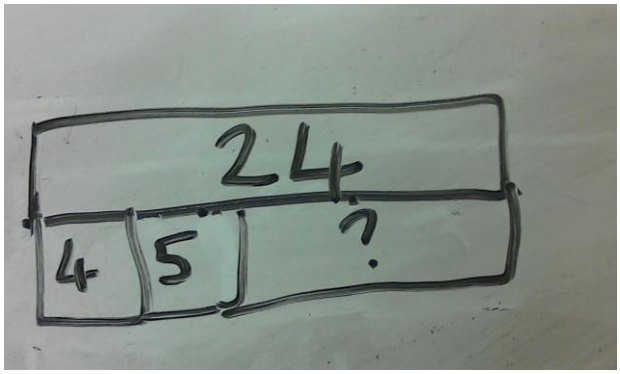
Mina sold **17** toffee apples.

How many toffee apples were left?



There are 24 children in the nursery.

4 boys and 5 girls go outside.
How many children are left inside the nursery?



10.2 Year 4

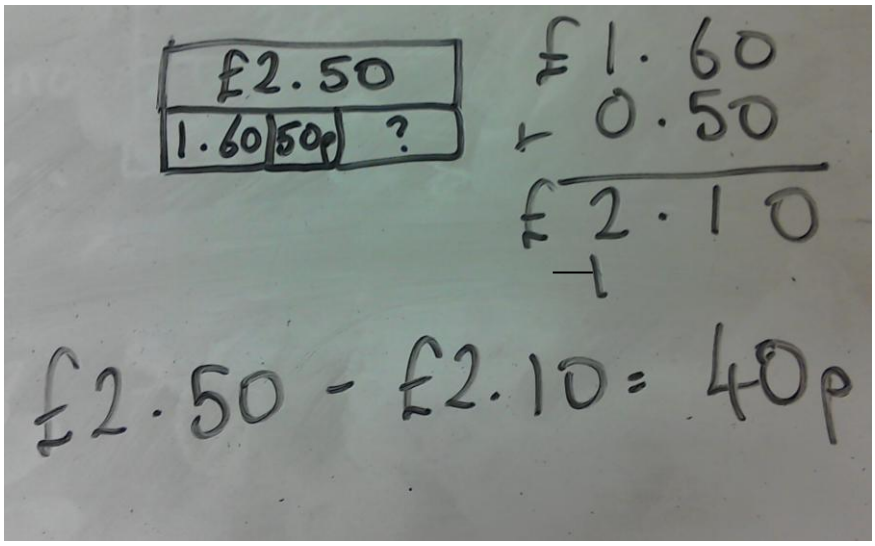
Liam, Sarah and Amy buy lunch at a salad bar.

salad bar			
Salads		Desserts	
cheese	£1.20	banana	25p
egg	90p	apple pie	50p
tuna	£1.60	yogurt	35p

Liam has £2.50 to spend.

He buys a tuna salad and an apple pie.

How much money has he got left?



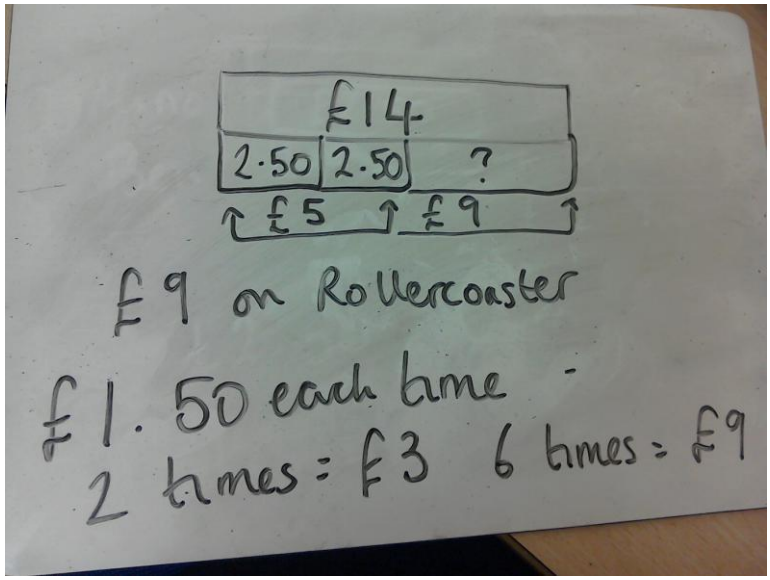
10.3 Year 5

Big Wheel £2.50 each ride	Rollercoaster £1.50 each ride

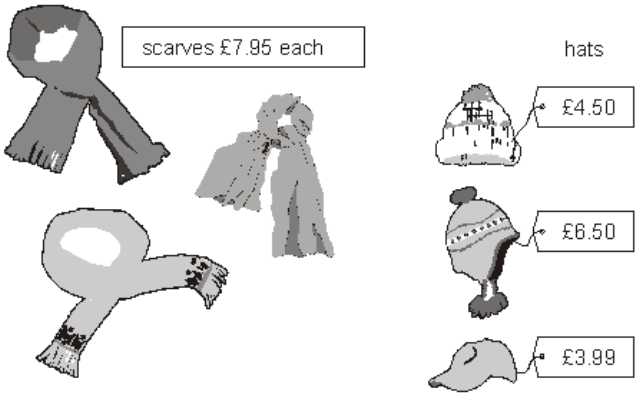
Liam spends £14 altogether on the Big Wheel and the Rollercoaster.

He goes on the Big Wheel twice.

How many times does he go on the Rollercoaster?

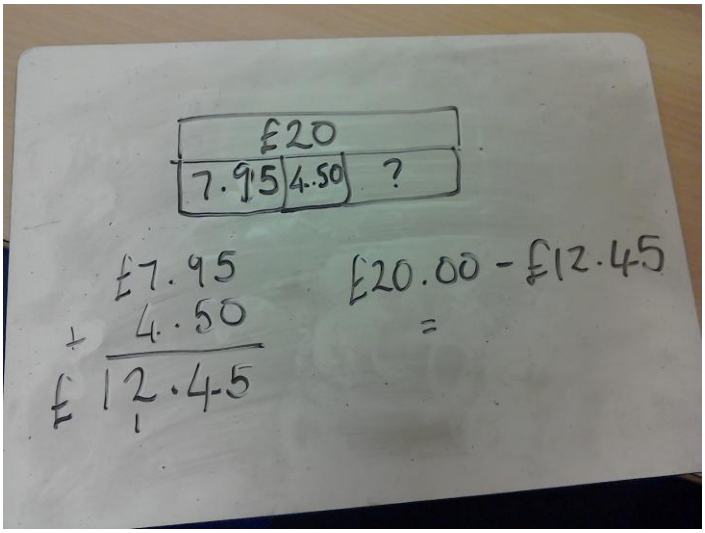


A shop sells scarves and hats.



Ben buys one of the scarves and the £4.50 hat.

How much change does he get from £20?



10.4 Year 6

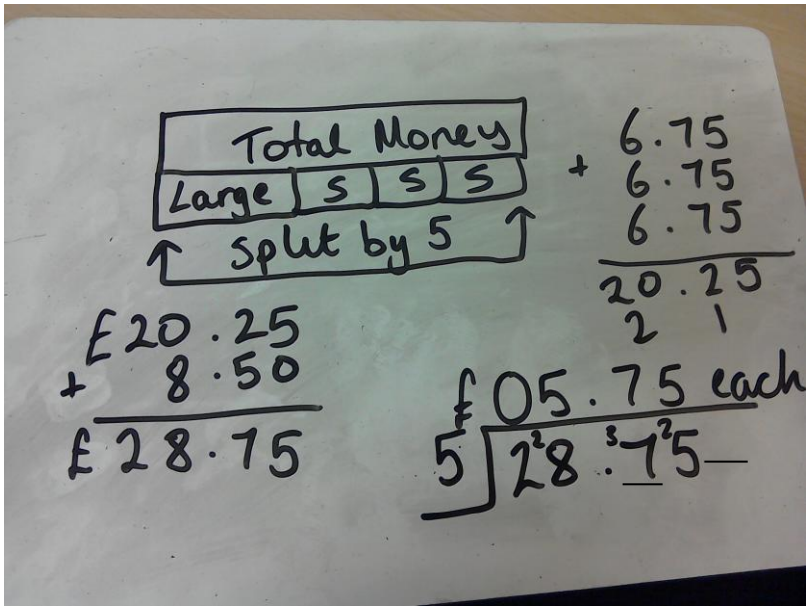
Large pizzas cost £8.50 each.

Small pizzas cost £6.75 each.

Five children together buy one large pizza and three small pizzas.

They share the cost equally.

How much does each child pay?



Further examples can be found at: http://www.mathplayground.com/thinkingblocks.html