Our Aims

Halfway Nursery Infant School

Calculation Policy

Halfway Nursery Infant School: Calculations Policy

Introduction: Mastery in Mathematics

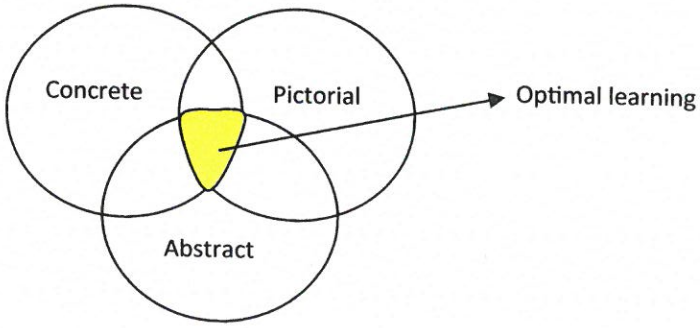
At the centre of the mastery approach to the teaching of mathematics is the belief that all children have the potential to succeed. Reasoning and greater depth questioning should be used to deepen the understanding of all pupils, not just the most able. All pupils should have access to the same curriculum content and, rather than be extended with new learning, they should deepen their conceptual understanding by tackling challenging and varied problems. Mastery should be interwoven into each lesson and activities should be provided to allow children to develop the characteristics of mastery.

Possible Characteristics of Mastery

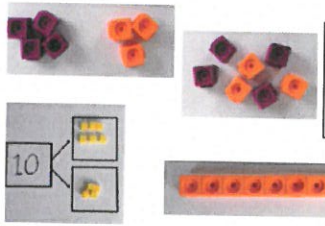
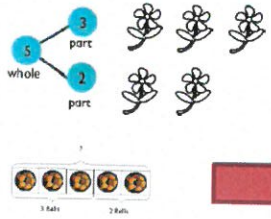
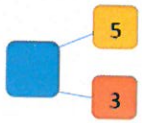
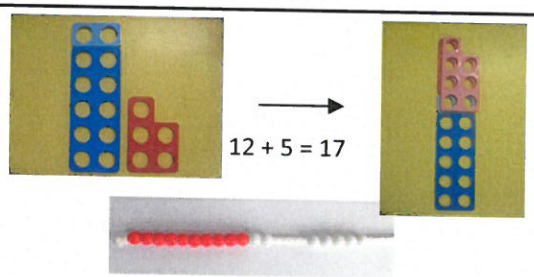
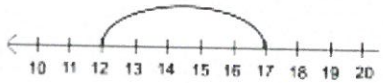
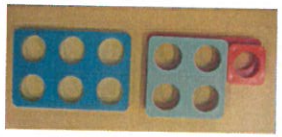
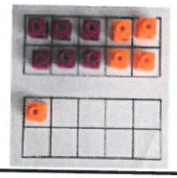
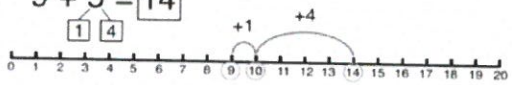
Independence	Can apply the skill or knowledge without referring to the teacher.
Fluency	Can apply the skill or knowledge with a high level of confidence.
Application	Can apply the skill or knowledge to a range of different contexts, including other areas of the curriculum.
Consistency	Can use their skills and understanding consistently.
Synthesis	Can organise ideas, information, or experiences into new, more complex interpretations and relationships.
Re-visit	Can return to this aspect of learning after a break and still fell confident that they can work on the skill or knowledge without difficulty.

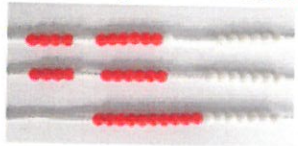
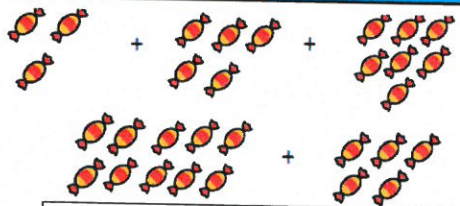
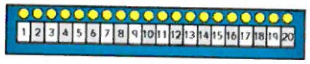
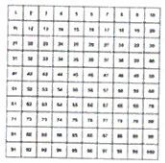
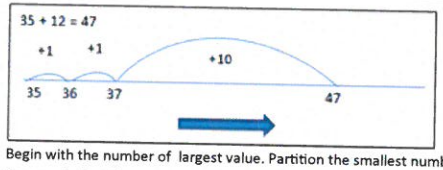
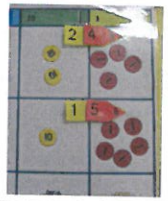
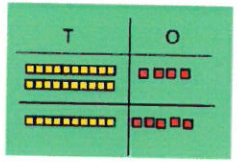
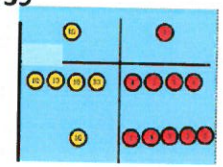
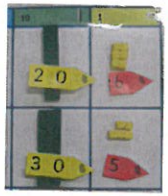
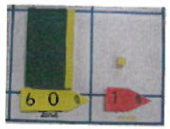
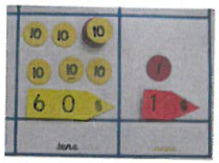
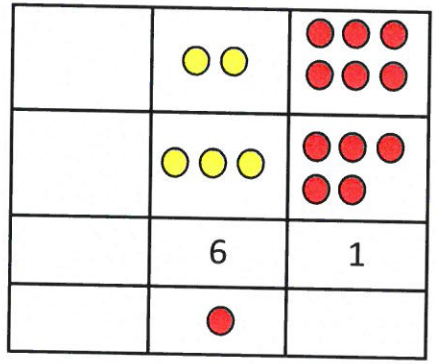
Similarly, with calculation strategies, children should not just learn procedures but in addition demonstrate their understanding through the use of concrete materials and pictorial representations.

The purpose of this policy is twofold. Firstly, it shows the progression of the calculation strategies (these are not specific to set year groups). Secondly, it demonstrates how concrete, pictorial and abstract representations can be used simultaneously to consolidate mastery learning. Additional abstract representations and reasoning examples have been given to allow all learners to develop the characteristics of mastery.

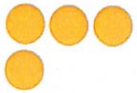
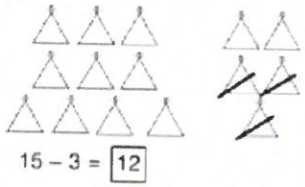
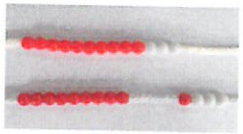
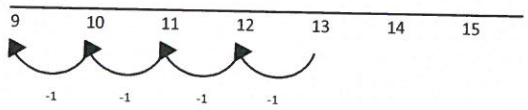
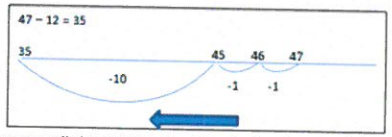
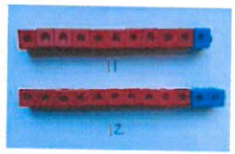
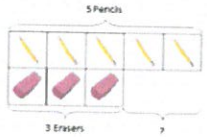
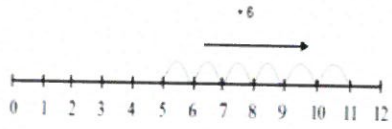
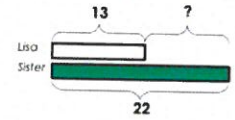


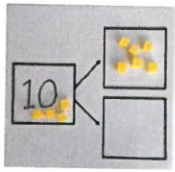
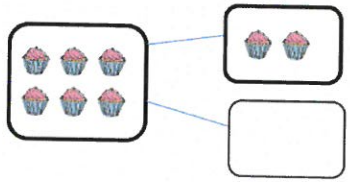
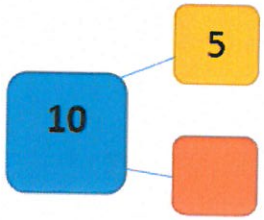
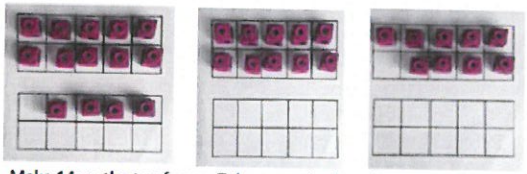
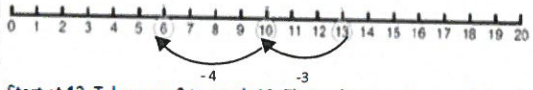
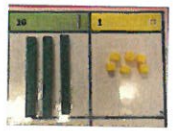
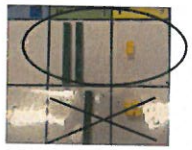
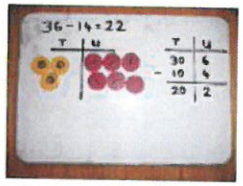
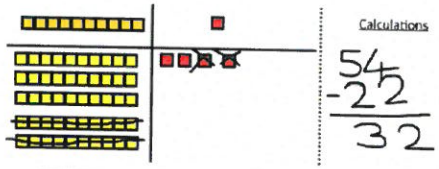
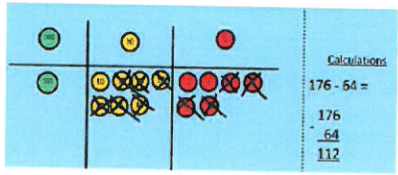
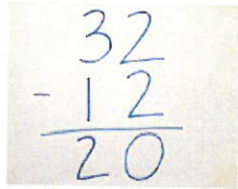
Addition

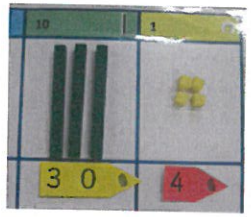
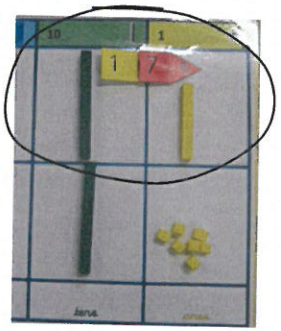
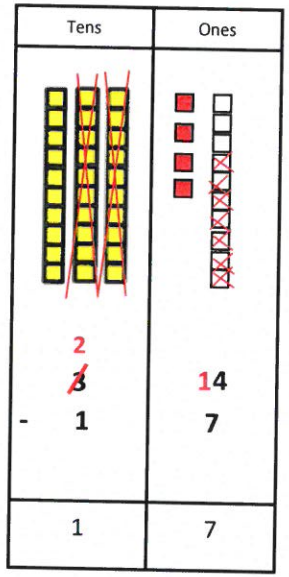
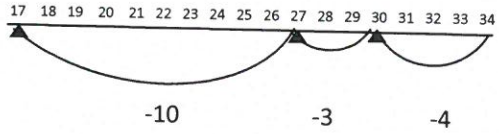
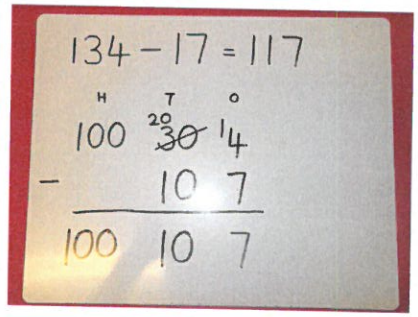
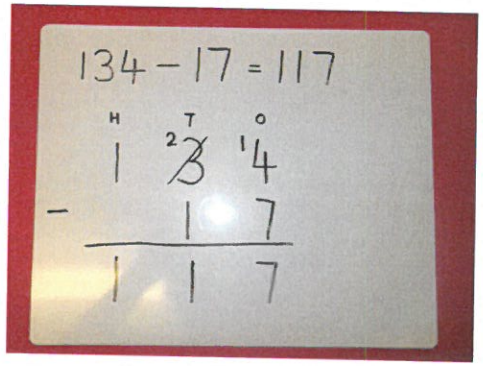
	Concrete	Pictorial	Abstract
Combine two parts to make a whole: part-whole model	 Use cubes to add two numbers together as a group or in a bar.	 Use pictures to add two numbers together as a group or in a bar. 	 Use the part-part whole diagram as shown above to move into the abstract. **4 + 3 = 7** **10= 6 + 4**
Starting at a bigger number and counting on.	 Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.	**12 + 5 = 17**  Start at the larger number on the number line and count on in ones or in one jump to find the answer.	**5 + 12 = 17** Place the larger number in your head and count on the smaller number to find your answer.
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 Use pictures or a number line. Regroup or partition the smaller number to make 10. 3 + 9 = 9 + 5 = 14 1 4 +1 +4 	7 + 4= 11 If I am at seven, how many more do I need to make 10. How many more do I add on now?

	Concrete	Pictorial	Abstract
Add three single digit numbers.	**4 + 7 + 6= 17** Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	4 + 7 + 6 = 10 + 7 10 = 17 Combine the two numbers that make 10 and then add on the remainder.
Addition of two 2 digit numbers on an empty number line.	Use a number track or 100 square to count on. Count on from the largest number.  	 Begin with the number of largest value. Partition the smallest number. Add the ones before the tens. Jump forwards on top of the number line..	35 + 12 = 47
Column method—no regrouping	**24 + 15=** Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.  	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. **24 + 15 = 39**  	Calculation: 24 + 15 = 39 **24** **+ 15**
Column method—regrouping	Make both numbers on a place value grid.   Add up the ones and exchange 10 ones for one 10.   26 + 35 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding. 	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 26 + 35 61 1

Subtraction

	Concrete	Pictorial	Abstract
Taking away ones.	Use physical objects, counters, cubes etc to show how objects can be taken away.  **6 – 2 = 4** 	Cross out drawn objects to show what has been taken away.   15 – 3 = 12	**18 -3= 15** **8 – 2 = 6**
Counting back.	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones. **13 – 4**  Use counters and move them away from the group as you take them away counting backwards as you go. 	Count back on a number line or number track.  Start at the bigger number and count back the smaller number showing the jumps under the number line.  This can progress all the way to counting back using two 2 digit numbers. After partitioning the 2 digit number to be subtracted; begin by counting back in ones and then move on to tens.	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.
Find the difference.	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference.	 Count on to find the difference. Draw bars to find the difference between 2 numbers. **Comparison Bar Models** *Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them.* 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.

	Concrete	Pictorial	Abstract
Part Part Whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? **10 - 6 =**	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers within the part whole model.
Make 10.	14 - 5 =  Make 14 on the ten frame. Take away the four first to make 10 and then takeaway one more so you have taken away 5. You are left with the answer of 9.	13 – 7 = 6 3 4  Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	**16 – 8=** How many do we take off to reach the next 10? How many do we have left to take off?
Column method without regrouping.	_ 36—14 =   Use Base 10 to make the bigger number then take the smaller number away.  Show how you partition numbers to subtract. Again make the larger number first.	Draw the Base 10 or place value counters alongside the written calculation to help to show working.  	This will lead to a clear written column subtraction. 

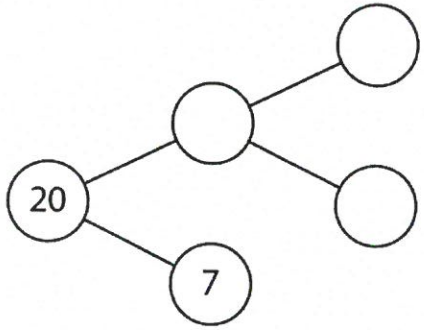
	Concrete	Pictorial	Abstract
Column method with regrouping.	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. 34 - 17 Make the larger number with base 10.  Start with the ones, can I take 7 away from 4 easily? I need to exchange one of my tens for ten ones.  2 1 ~~3~~ 4 - 1 7 1 7 Now I can subtract 7 ones and then 1 ten. The answer is 17. Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.	Draw the base 10 on to a place value grid and show what you have taken away by crossing out the base 10 and clearly showing the exchanges you make.  You can also show subtraction on a number line.  	 Children can start their formal written method by partitioning the number into clear place value columns.  Moving forward the children will use a more compact method.

Addition and Subtraction Y1

Greater depth

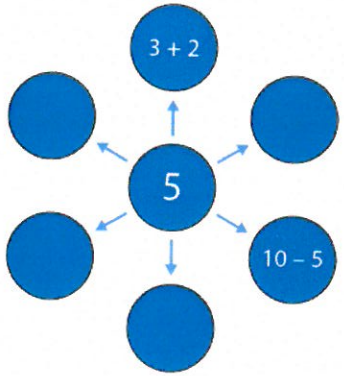
Use these abstract representations to extend your pupils' understanding and to help them achieve greater depth:

Complete:



Now create a similar diagram.
Can you extend your diagram?

If you know one fact, what other facts do you know?
Complete:



Complete:

$3 + \square + 3 = 9$

$7 + \square + 1 = 10$

$6 + 3 + \square = 9$

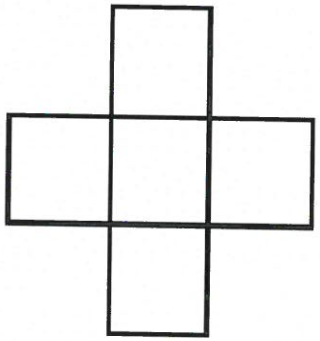
$7 + 1 + \square = 11$

If I start on 0 and count on in fives will I say the number 55?

If I start on 4 and count on in twos will I say the number 17?

If I start at 10 and count on in tens will I say 100?

Write the numbers 1 to 5 in the squares so that each row and column adds up to the same number, called the 'magic number'. What is the 'magic number'?



I'm thinking of a number. I've subtracted 5 and the answer is 7. What number was I thinking of? Explain how you know.

I'm thinking of a number. I've added 8 and the answer is 19. What number was I thinking of? Explain how you know.

I know that 7 and 3 is 10. How can I find 8 + 3? How could you work it out?

Show children a price list with items costing up to 20p.
I have 20p to spend. If I spend 20p exactly, which two items could I buy?
And another two, and another two.

If I bought one of the items how much change would I have? And another one, and another one.

Addition and subtraction: Reasoning Focus Y1

Represent and use number bonds and related subtraction facts within 20.	Add and subtract one-digit and two-digit numbers to 20, including zero.	Read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs .	Solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = ☐ - 9
Continue the pattern 10 + 8 = 18 11 + 7 = 18 Can you make the similar pattern for the number 17? How would this pattern look if it included subtraction? **Missing numbers** 9 + ☐ = 10 10 - ☐ = 9 What number goes in the missing box?	**Working backwards** Through practical games on number tracks and lines ask questions such as "where have you landed?" and "what numbers would you need to throw to land on other given numbers?". **What do you notice?** 11—1=10 11—0=1 Can you make up some other calculations like this involving 3 different numbers?	**Fact families** Which four calculations link these numbers? 12, 15, 3 **What else do you know?** If you know this: 12—9 = 3 What other facts do you know? **Missing symbols** Write the missing symbols (+ - =) in these calculations: 17 ☐ 3 ☐ 20 18 ☐ 20 ☐ 2 **Convince me** In my head I have two odd numbers with a difference of 2. What could they be? Convince me. **Is it true that?** Is it true that 3+4=4+3?	

Addition and Subtraction Y2

Greater depth

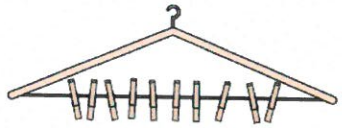
Use these abstract representations to extend your pupils understanding and to help the pupils gain greater depth:

Find different possibilities.

□ + □ = 50

50 − □ = □

If each peg on the coat hanger has a value of 10, find three ways to partition the pegs to make the calculations complete:



□ + □ + □ = □

□ + □ + □ = □

□ + □ + □ = □

What is the total of each addition sentence?
Will the total always be the same?
Explain your reasoning.

'An odd number + an odd number + an odd number = an even number'. Is this sometimes, always or never true?

Explain your reasoning.

Concrete resources might help pupils to explain their reasoning.

Complete the calculations.

30 + 40 + □ = 100

40 + □ + 20 = 100

36 + 44 + □ = 100

36 + 54 + □ = 100

47 + □ + 20 = 100

47 + □ + 30 = 100

Insert numbers to make these calculations correct.

13 − ___ < 6

13 − ___ < 6 13 − ___ < 6 13 − ___ < 6

13 − ___ < 6 13 − ___ < 6 13 − ___ < 6

I think of a number and I add 2. The answer is 17. What was my number?

I think of a number and I subtract 5. The answer is 24. What was my number?

Addition and Subtraction Y2

Greater depth continued....

Fill in the missing numbers. What do you notice?

27	
15	?

12	15
?	

37	
15	?

23	14
?	

13	14
?	

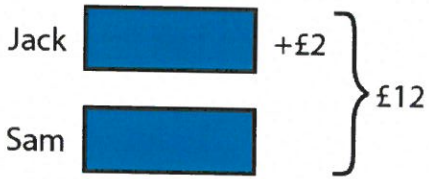
57	
15	?

Together Jack and Sam have £12.

Jack has £2 more than Sam.

How much money does Sam have?

A bar model can be very helpful in solving these types of problems.



£12 – £2 = £10

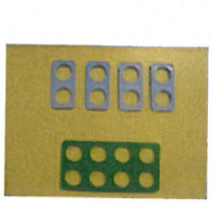
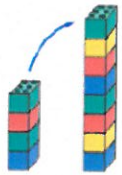
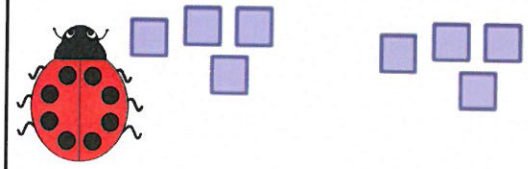
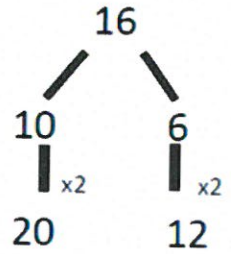
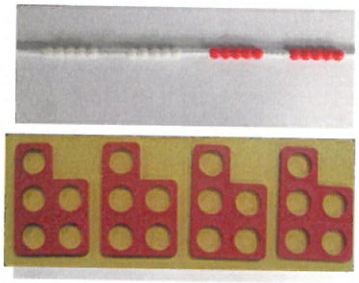
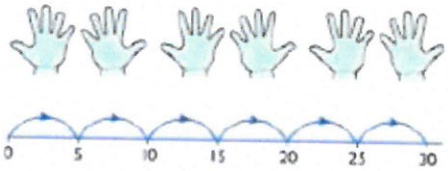
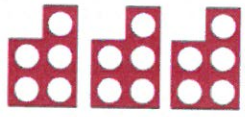
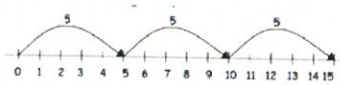
£10 ÷ 2 = £5

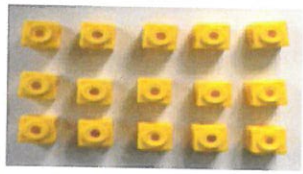
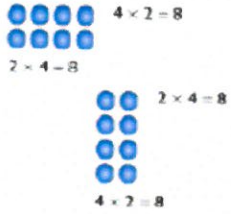
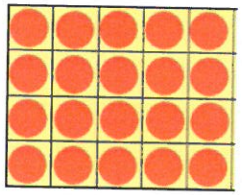
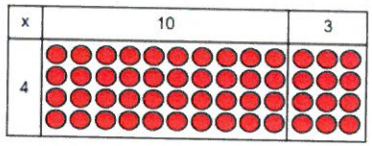
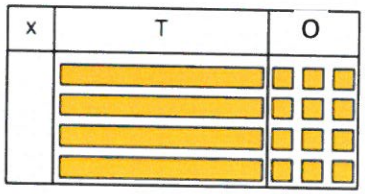
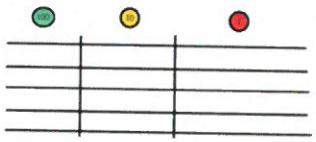
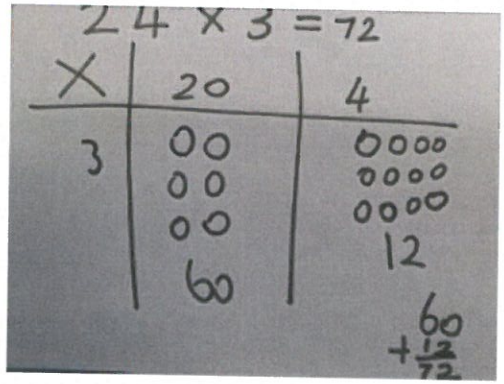
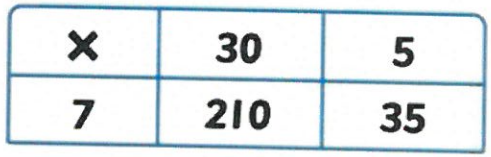
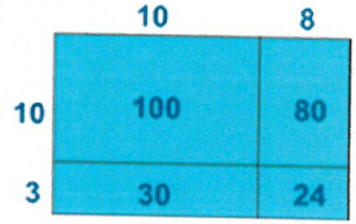
Sam has £5

Addition and subtraction: Reasoning Focus Y2

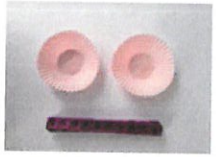
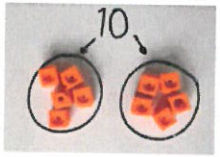
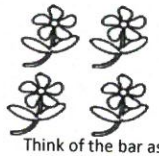
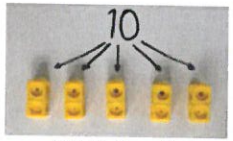
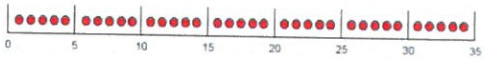
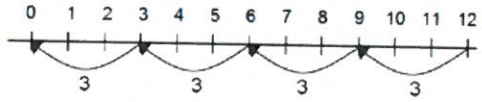
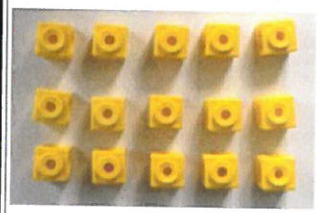
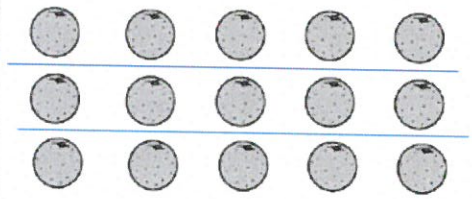
Recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100.	Add and subtract numbers using concrete objects, pictorial representations, and mentally, including: • a two-digit number and ones • a two-digit number and tens • two two-digit numbers • adding three one-digit numbers	Show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot.	Recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.
Continue the pattern 91 = 100 - 10 80 = 100 - 20 Can you make the similar pattern starting with the numbers 74, 26 and 100? **Missing numbers** 91 + ☐ = 100 100 - ☐ = 89 What number goes in the missing box?	**True or false?** Are these calculations true or false? 73+40=113 98-18=70 46+77=123 92-67=35 Give your reasons. **Hard and easy questions** Which questions are easy/hard? 23+10 = 93+10= 54+9= 54+1= Explain why you think hard questions are hard? **Other possibilities** ☐ + ☐ + ☐ = 14 What single digit numbers could go in the boxes? How many different way can you do this?	**Fact families** Which four calculations link these numbers? 100, 67, 33 **What else do you know?** If you know this: 87 = 100 –13 What other facts do you know? **Missing symbols** Write the missing symbols (+ - =) in these number sentences: 80 ☐ 20 ☐ 100 100 ☐ 70 ☐ 30 87 ☐ 13 ☐ 100	**Making an estimate** Which of these calculations have the answer that is between 50 and 60 74—13 55 + 17 87—34 **Always, sometimes, never** Is it always, sometimes or never true that if you subtract a multiple of 10 from any number the units digit of that number stays the same? Is it always, sometimes or never true that when you add two numbers together you will get an even number?
			Solve problems with addition and subtraction: * using concrete objects and pictorial representations, including those involving numbers, quantities and measures. * Apply their increased knowledge of mental and written methods.

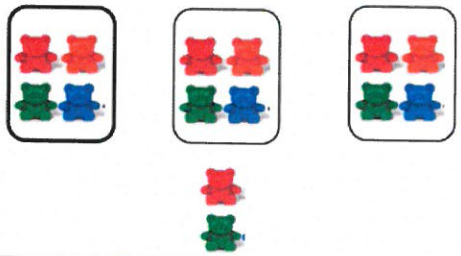
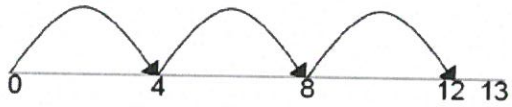
Multiplication

	Concrete	Pictorial	Abstract
Doubling.	Use practical activities to show how to double a number.   double 4 is 8 4 x 2 = 8 4 x 2 = 8	Draw pictures to show how to double a number. Double 4 is 8 	Partition a number and then double each part before recombining it back together.  16 10 x2 20 6 x2 12 Double 8 8x2 = Double 3 3 x2 =
Counting in multiples.	 Count in multiples supported by concrete objects in equal groups.	 0 5 10 15 20 25 30 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. **2, 4, 6, 8, 10** **5, 10, 15, 20, 25, 30**
Repeated addition.	  Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 5 + 5 + 5 = 15	Write addition calculations to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10

	Concrete	Pictorial	Abstract
Arrays—showing commutative multiplication.	Create arrays using counters/cubes to show multiplication calculations.  	Draw arrays in different rotations to find commutative multiplication calculations.   Link arrays to area of rectangles.	Use an array to write multiplication calculations and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15
Grid method.	Show the link with arrays to first introduce the grid method.  4 rows of 10 4 rows of 3 Move on to using Base 10 to move towards a more compact method.  4 rows of 13 Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.  Calculations 4 x 126	Children can represent the work they have done with place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.  	Start with multiplying by one digit numbers and showing the clear addition alongside the grid.  210 + 35 = 245 Moving forward, multiply by a 2 digit number showing the different rows within the grid method. 

Division

	Concrete	Pictorial	Abstract
Sharing objects into groups.	   I have 10 cubes, can you share them equally in 2 groups? 10 ÷ 2 = 5	Children use pictures or shapes to share quantities  8 ÷ 2 = 4   20 ÷ 5 = ? 5 x ? = 20 Think of the bar as a whole. Split it into the number you are dividing by and work out how many would be within each group.	**Share 9 buns between three people.** **9 ÷ 3 = 3**
Division as grouping.	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.  10 ÷ 5 = 2 96 ÷ 3 = 32   	Use a number line to show jumps in groups. The number of jumps equals the number of groups. 	**28 ÷ 7 = 4** **Divide 28 into 7 groups. How many are in each group?**
Division within arrays.	 Link division to multiplication by creating an array and thinking about the number calculations. That can be created. E.g. 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division calculations.	Find the inverse of multiplication and division sentences by creating 4 linking calculations. **7 x 4 = 28** **4 x 7 = 28** **28 ÷ 7 = 4** **28 ÷ 4 = 7**

	Concrete	Pictorial	Abstract
Division with a remainder.	**14 ÷ 3 =** Divide objects between groups and see how much is left over 	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.  Draw dots and group them to divide an amount and clearly show a remainder. 	Complete written divisions and show the remainder using r. 29 ÷ 8 = 3 REMAINDER 5 ↑ dividend ↑ divisor ↑ quotient ↑ remainder

Multiplication and Division Y1

Greater depth

Use these abstract representations to extend your pupils understanding and to help them achieve greater depth:

How else could 20 sweets be put into bags so that every bag had the same number of sweets?

How many bags would be packed each time?

If you counted back from 50 in tens, would you say 0?

Can you explain?

Toy aeroplanes have 5 wheels.

How many wheels would you need to make different numbers of aeroplanes?

Using only 2p, 5p and 10p coins, can you show 20p?

In how many different ways can you do this?

Are you sure you have got them all?

Explain how you know.

Lollies cost 5p each.
A pack of 3 lollies costs 13p.

How much money do you save when you buy a pack of 3 lollies instead of 3 single lollies?

If I start on 0 and count on in fives will I say the number 55?

If I start on 4 and count on in twos will I say the number 17?

If I start at 10 and count on in tens will I say 100?

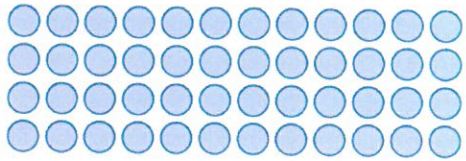
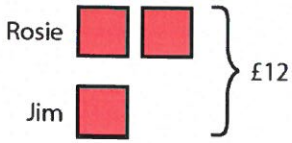
Captain Conjecture says, 'I can double any number, but I can only halve some numbers'.
Do you agree?

Explain your reasoning.

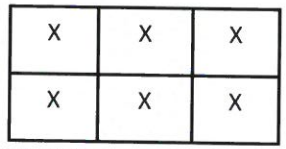
Multiplication and Division Y2

Greater depth

Use these abstract representations to extend your pupils understanding and to help the pupils gain greater depth:

Which has the most biscuits: 4 packets of biscuits with 5 in each packet, or 3 packets of biscuits with 10 in each packet? Explain your reasoning.	Write these addition sentences as multiplication sentences. 10 + 10 + 10 + 5 + 5 = 2 + 2 + 2 + 4 = 2 + 2 + 4 + 4 = 5 + 5 + 5 + 2 + 3=	Find different ways to find the answer to 12 × 4.  Children are expected to use their 2, 5 and 10 times tables to answer this.
True or false? $5 \times 4 = 4 \times 5$ $5 \times 4 = 10 \times 2$ $5 \times 4 = 2 \times 10$ Explain your reasoning. What do you notice?	Together Rosie and Jim have £12. Rosie has twice as much as Jim. How much does Jim have? *The bar model can be helpful in solving these types of problems.*  12 ÷ 3 = 4 Jim has £4	Two friends wants to buy some marbles and then share them out equally between them. They could buy a bag of 13 marbles, a bag of 14 marbles or a bag of 19 marbles. What size bag should they buy so that they can share them equally? What other numbers of marbles could be shared equally? Explain your reasoning.

Multiplication and Division: Reasoning Focus Y1 and Y2

Y1	Y2	Y2	Y2
Count in multiples of twos, fives and tens	Count in steps of 2, 3 and 5 from 0, and in tens from any number forwards and backwards. Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers.	Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot	Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (x) and division (÷) and equals (=) signs
Making links If one teddy has two apples, how many apples will three teddies have? Here are 10 lego people. If 2 people fit into the train carriage, how many carriages do we need? **Practical** If we put two pencils in each pot how many pencils will we need? **Spot the mistake** Use the puppet to count but make some deliberate mistakes. E.g. 2 4 5 6 10 9 8 6 See if pupils can spot the deliberate mistake and correct the puppet.	**Missing Numbers** **10 = 5 x □** **What number could be written in the box?** **Making links** I have 30p in my pocket in 5p coins. How many coins do I have?	**Making links** Write the multiplication number sentences to describe this array  What do you notice? Write the division sentences.	**Prove it** Which four number sentences link these number? 3, 5, 15? Prove it. **True or false?** When you count up in tens starting at 5 there will always be 5 units. **Use the inverse** Use the inverse to check if the following calculations are correct: 12 ÷ 3 = 4 3 x 5 = 14
Solve one—step problems involving multiplication and division by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.			Solve one—step problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Mathematical language

Correct Terminology	Incorrect Terminology
ones	units
is equal to (is the same as)	equals
zero	oh (the letter o)
exchange exchanging regrouping	borrowing stealing
Calculation—addition, subtraction, multiplication, division equation	Generic term of 'sum' or 'number sentence'
known unknown	
whole part	