Pilsley CofE Primary School Calculation Policy

This policy gives examples of the models and images that are used on a daily basis and incorporated into our weekly planning. They are taken from:

Maths - No Problem!

Mastery PD Materials: NCETM; East Midlands West Maths Hub

White Rose Maths

Ready to Progress Criteria, 2020 DFE Recovery Curriculum Maths Guidance

Pilsley CofE Primary School Teaching for Mastery Maths Calculation Policy: Representations, Models and Images
All images are taken from NCETM PD Materials / DFE 2020 Curriculum Guidance / Maths No Problem and White Rose Maths

This policy supports the Teaching for Mastery approach that is taught throughout the school. The school uses Maths No Problem! as its core scheme for Years 1 - 6, alongside the NCETM PD materials and White Rose Maths for support materials. TTRock Stars is used to maintain fluency in multiplication facts from Year 3. EYFS uses White Rose Maths and NCETM materials.

This calculation policy gives examples of a range of representations, models and images that demonstrate how maths in our school is taught. Each representation is from one of the schemes stated above and is key to supporting children to develop a deep understanding of number and calculation. Teachers use these to model calculations through a concrete, pictorial and abstract (CPA) approach.

- **Concrete is the "doing" stage. During this stage, students use concrete objects to model problems.**
- **Pictorial is the "seeing" stage. Here, visual representations of concrete objects are used to model problems. This stage encourages children to make a mental connection between the physical object they just handled and the abstract pictures, diagrams or models that represent the objects from the problem.**
- **Abstract is the "symbolic" stage, where children use abstract symbols to model problems. Students will not progress to this stage until they have demonstrated that they have a solid understanding of the concrete and pictorial stages of the problem.**

Lesson design: When planning a lesson, teachers consider:

- **Cohesion:** small steps are taken, with all children beginning with the same problem. The teacher plans for misconceptions that might arise, or have arisen in previous learning and supports these through the use of carefully structured oral and written questions that the children work on and discuss as a whole group before proceeding to individual or paired work.
- **Mathematical Thinking**: children are supported by the use of Stem Sentences within a lesson, which give scaffolding for support and allow the teacher to consider extension questions. Children are given time to consider the 'in focus' task at the beginning of the lesson and to establish efficient ways of solving the problem.
- **Representations and Structure:** children are given a range of similar models and images from Reception to Year 6 that progressively build on their knowledge and understanding (eg, the whole: part-part diagram or bar models)
- **Variation and Intelligent Practise:** teachers use the representations shown in the policy and vary them within a lesson in small steps until the objective has been achieved. Teachers encourage the children to look for and discuss patterns within their thinking and make connections with previous learning.
- **Fluency**: efficient calculation requires having a variety of mental strategies. Children are encouraged to use retrieval skills and to make comparisons, for example by answering 'what is the same and what is different between the 3 and 6 x tables?'. As the children develop instant recall alongside conceptual understanding, they begin to see patterns and work more systematically.

Mental and written methods: Children are taught strategies that establish a secure understanding of place value, such as counting forwards and backwards in ones and tens. Children are given opportunities to explain and reason why they have chosen a strategy and whether it is the most efficient. The formal written methods are introduced when children can demonstrate understanding with concrete apparatus, proving that place value is secure. Calculations that require a written method should be presented to the children with apparatus alongside models and images, such as dienes apparatus or place value counters. This ensures that they have a conceptual understanding of the written method and that it is not a process that the children use for every type of calculation regardless of whether it can be completed mentally or mentally with jotting for example, by using a the number line or whole: part,part diagram.

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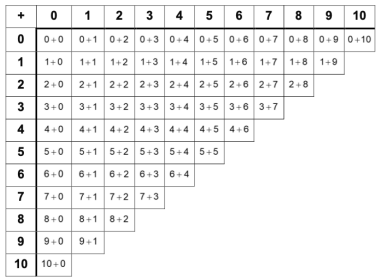
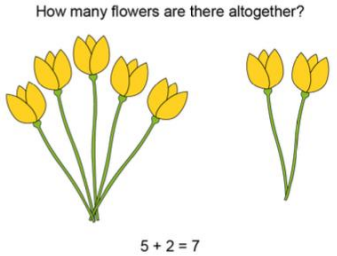
Year 1 Addition and Subtraction Representations, Models and Images

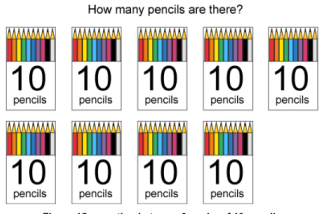
Represent and use number bonds and related subtraction facts within 20

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

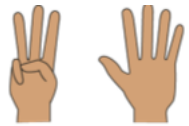


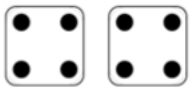


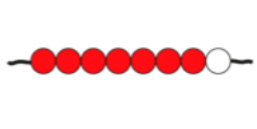


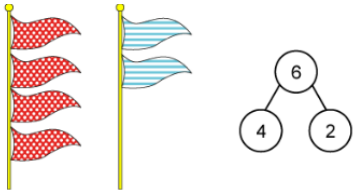
Solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as
7 = □ - 9

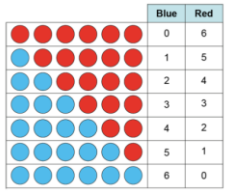
8 is…

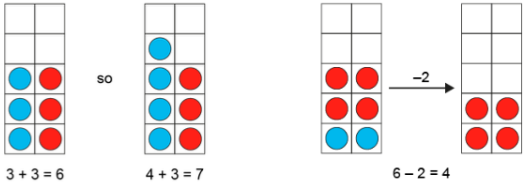




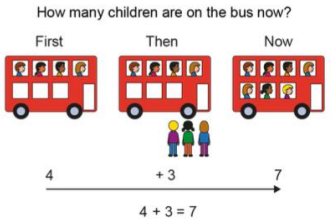


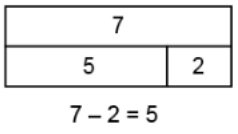


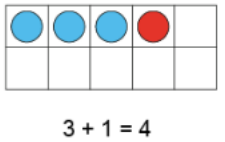




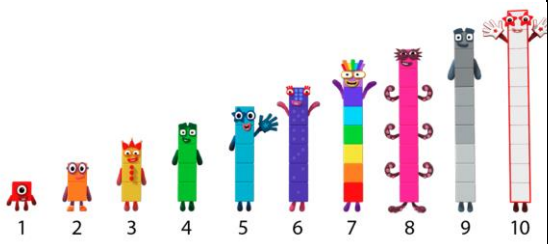
5 + 2 = □ 6 + 4 = □
5 + □ = 8 □ + 1 = 7

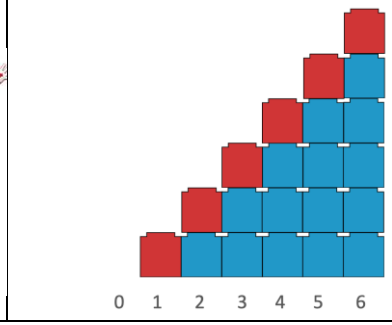


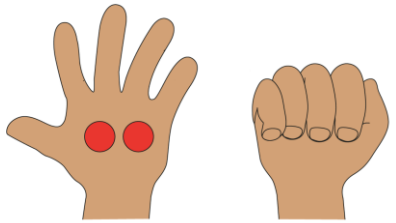


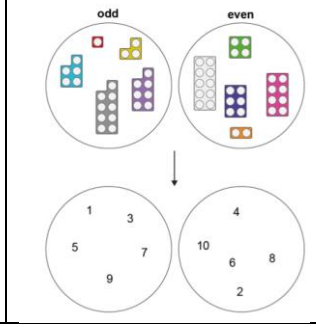


8 − 7 = □ 7 − 2 = □
□ − 3 = 4 9 − □ = 7









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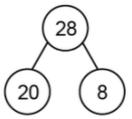
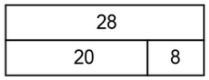
Year 2 Addition and Subtraction Representations, Models and Images

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

+	0	1	2	3	4	5	6	7	8	9	10
0	0+0	0+1	0+2	0+3	0+4	0+5	0+6	0+7	0+8	0+9	0+10
1	1+0	1+1	1+2	1+3	1+4	1+5	1+6	1+7	1+8	1+9	
2	2+0	2+1	2+2	2+3	2+4	2+5	2+6	2+7	2+8		
3	3+0	3+1	3+2	3+3	3+4	3+5	3+6	3+7			
4	4+0	4+1	4+2	4+3	4+4	4+5	4+6				
5	5+0	5+1	5+2	5+3	5+4	5+5					
6	6+0	6+1	6+2	6+3	6+4						
7	7+0	7+1	7+2	7+3							
8	8+0	8+1	8+2								
9	9+0	9+1									
10	10+0										



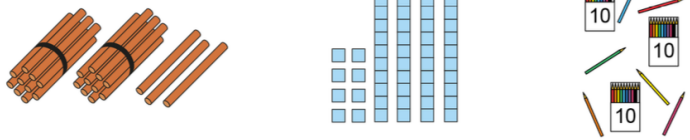


$20+8=28$ $28-20=8$
$8+20=28$ $28-8=20$

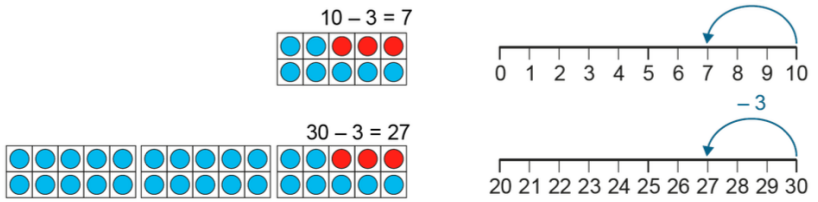
$28=20+8$ $8=28-20$
$28=8+20$ $20=28-8$

Solve problems with addition and subtraction:
using concrete objects and pictorial representations, including those involving numbers, quantities and measures
applying their increasing knowledge of mental and written methods

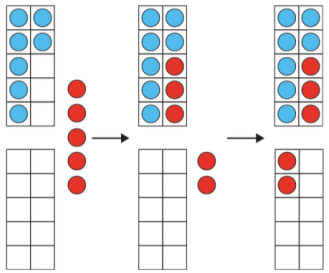
Partitioning:



Variation:

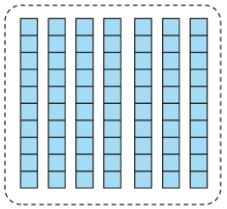


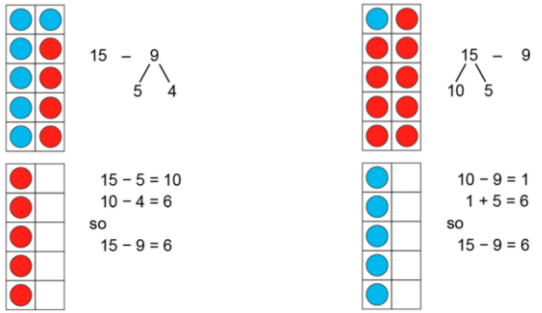
Use of tens frame:



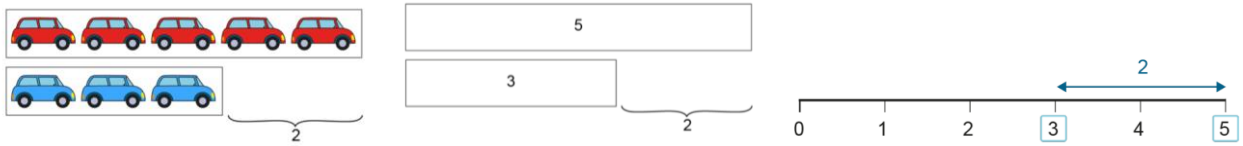
Making connections:

7 – 4 = 3
70 – 40





Using the bar model and numberline to find difference



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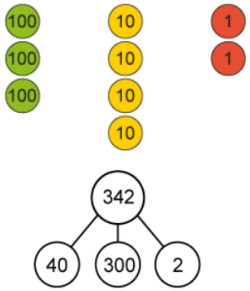
Year 3 Addition and Subtraction Representations, Models and Images

Add and subtract numbers mentally, including:
a three-digit number and ones
a three-digit number and tens
a three-digit number and hundreds

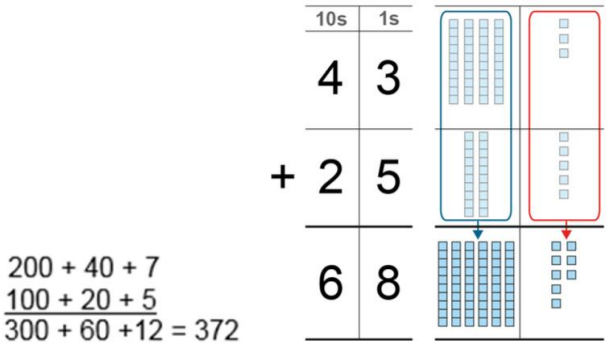
Add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction

+	0	1	2	3	4	5	6	7	8	9	10
0	0+0	0+1	0+2	0+3	0+4	0+5	0+6	0+7	0+8	0+9	0+10
1	1+0	1+1	1+2	1+3	1+4	1+5	1+6	1+7	1+8	1+9	1+10
2	2+0	2+1	2+2	2+3	2+4	2+5	2+6	2+7	2+8	2+9	2+10
3	3+0	3+1	3+2	3+3	3+4	3+5	3+6	3+7	3+8	3+9	3+10
4	4+0	4+1	4+2	4+3	4+4	4+5	4+6	4+7	4+8	4+9	4+10
5	5+0	5+1	5+2	5+3	5+4	5+5	5+6	5+7	5+8	5+9	5+10
6	6+0	6+1	6+2	6+3	6+4	6+5	6+6	6+7	6+8	6+9	6+10
7	7+0	7+1	7+2	7+3	7+4	7+5	7+6	7+7	7+8	7+9	7+10
8	8+0	8+1	8+2	8+3	8+4	8+5	8+6	8+7	8+8	8+9	8+10
9	9+0	9+1	9+2	9+3	9+4	9+5	9+6	9+7	9+8	9+9	9+10
10	10+0	10+1	10+2	10+3	10+4	10+5	10+6	10+7	10+8	10+9	10+10

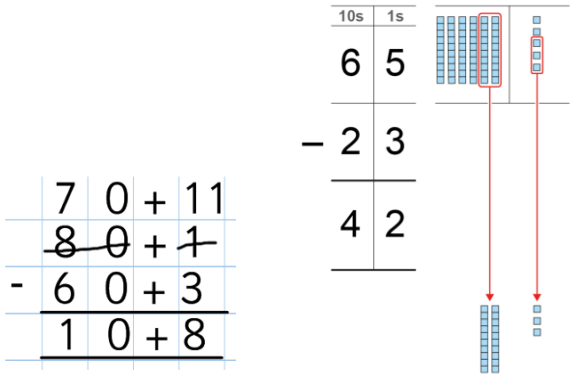


Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction

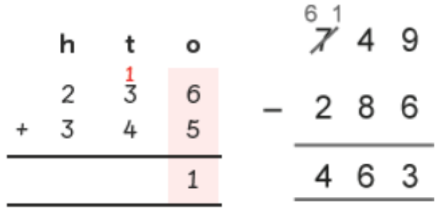
Towards formal written methods of column addition

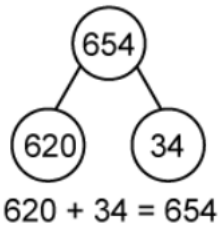


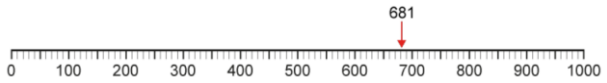
Towards formal written methods of column subtraction

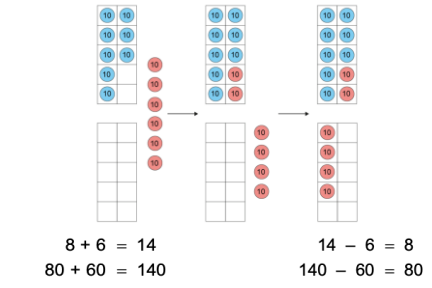


Formal written methods of columnar addition and subtraction









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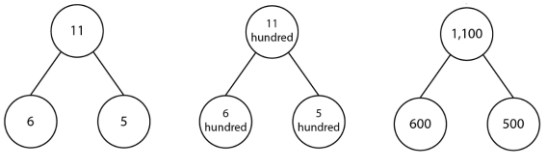
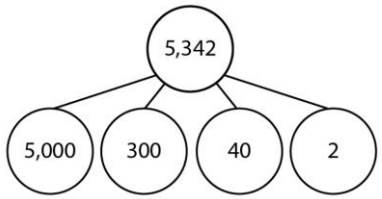
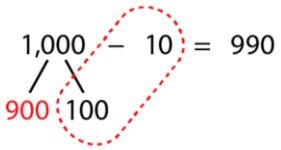
Year 4 Addition and Subtraction Representations, Models and Images

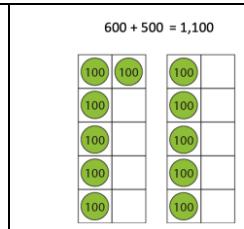
Add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate

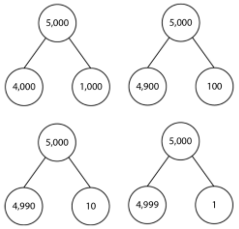


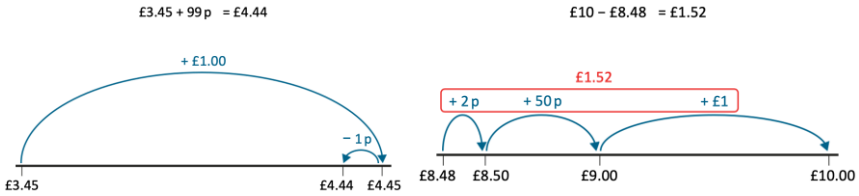


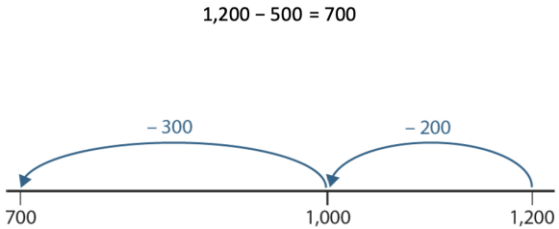
Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why

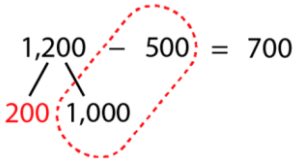


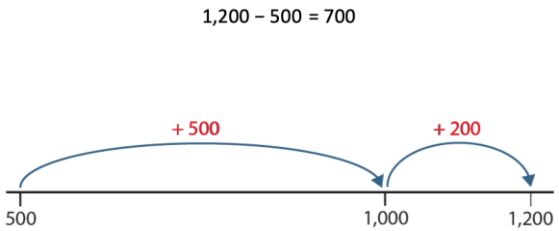






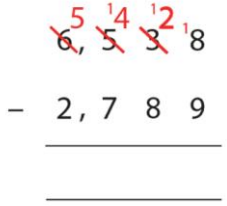






Formal written methods of addition and subtraction

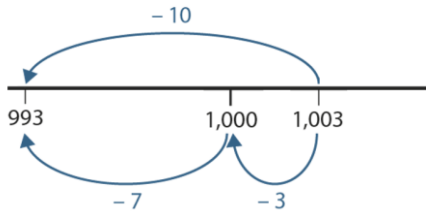
6,538 – 2,789 = 3,749



Compensating

7,000 – 2,648 = 6,999 – 2,647 = 4,352

1,003 – 10 = 993



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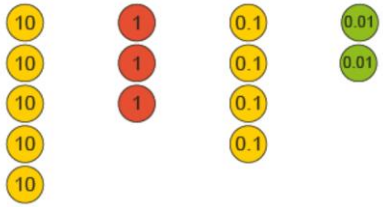
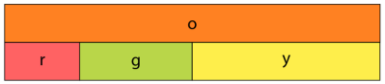
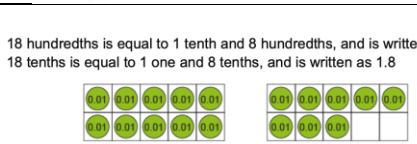
Year 5 Addition and Subtraction Representations, Models and Images

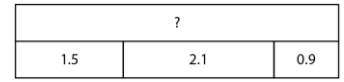
Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)

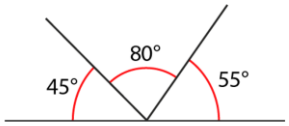


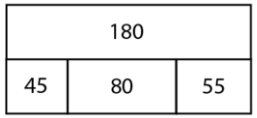
Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

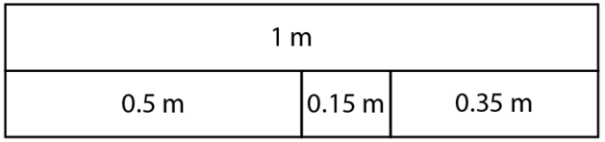


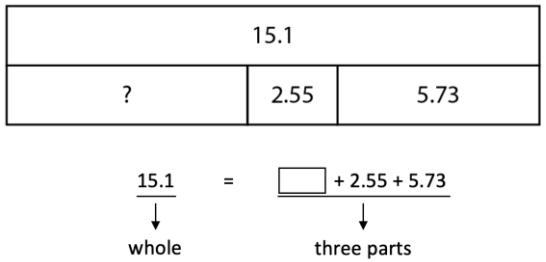


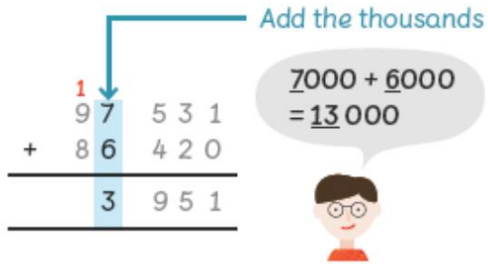




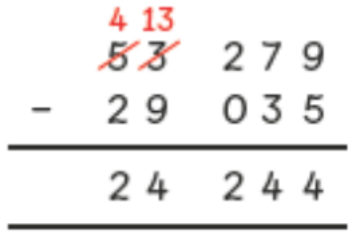




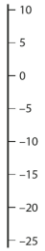




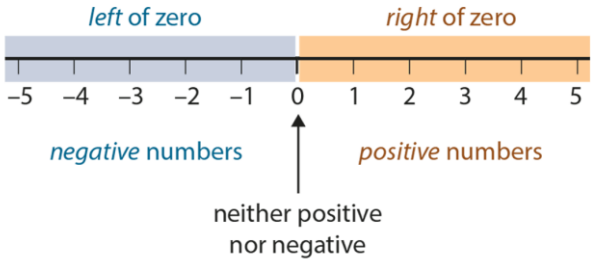
Formal written method (columnar addition)

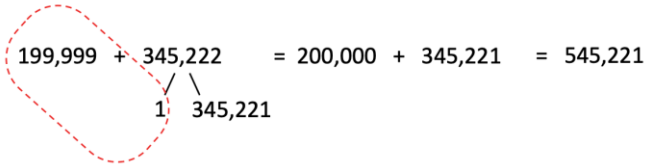


Formal written method (columnar subtraction)



Negative numbers





Compensation and equivalence

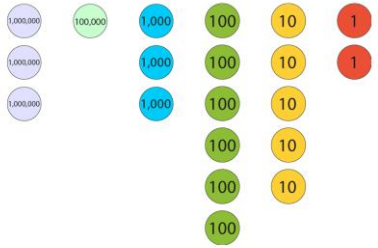
Pilsley CofE Primary School Teaching for Mastery Maths Calculation Policy: Representations, Models and Images
All images are taken from NCETM PD Materials / DFE 2020 Curriculum Guidance / Maths No Problem and White Rose Maths

Year 6 Addition and Subtraction Representations, Models and Images

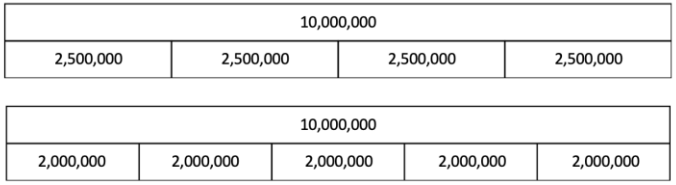
Perform mental calculations, including with mixed operations and large numbers
Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)

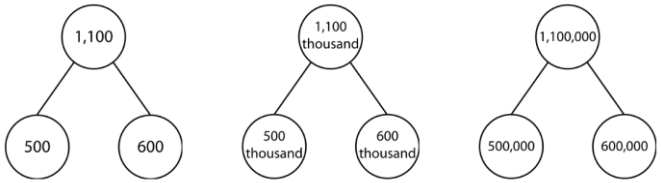
10,000,000	20,000,000	30,000,000	40,000,000	50,000,000	60,000,000	70,000,000	80,000,000	90,000,000
1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	70	8	9
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09

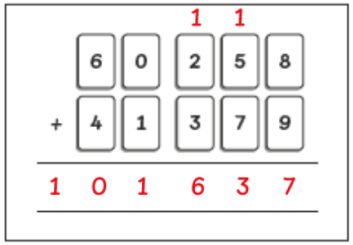
Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why



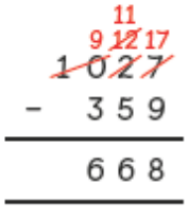
3,103,652





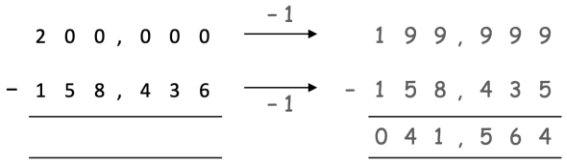


Formal written method (columnar addition)



Formal written method (columnar subraction)

200,000 − 158,436 = 41,564



Compensation and equivalence

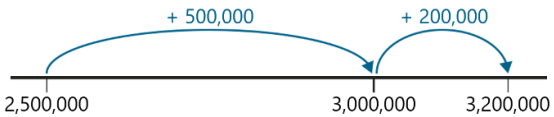
European country	Area (km²)
France	643,801
Spain	505,370
Sweden	450,295
Germany	357,022
United Kingdom	243,610

357,022	
243,610	?

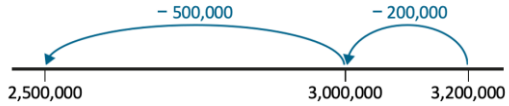
243,610 + ☐ = 357,022

357,022 − 243,610 = ☐

2,500,000 + 700,000 = 3,200,000



3,200,000 − 700,000 = 2,500,000



Examples of stem sentences that are used alongside the Representations, Models and Images:

The whole has been divided into ___ equal/ unequal parts.

Even numbers can be partitioned into two odd parts or two even parts.

Products in the four times table are also in the two times table.

One hundred one thousands make one hundred thousand.

There are ___ in the whole group.

There are ___ in this part of the group.