National Curriculum Programme of Study:

- Add and subtract numbers mentally with increasingly large numbers
- Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- Solve addition and subtraction multi-step problems in contexts, deciding which operations to use and why
- Solve problems involving converting between units of time

Y5

MENTAL CALCULATION
Addition & Subtraction

FLUENCY

By the end of Year 5, pupils should fluently derive and recall:

- Sums and differences of decimals, e.g. 6.5 + 2.7, 7.8 - 1.9
- What must be added to reach the next 10 from a decimal number, e.g. 13.6 + 6.4 = 20
- Sums and differences of 1 or 2-digit multiples of 10, 100, 1000, 10 000, and 100 000, e.g. 8 000 + 17 000, 600 000 - 20 000
- Sums and differences of near multiples of 10, 100, 1000, 10 000 and 100 000 to other numbers, e.g. 82 472 + 30 004, 82 472 – 30 004
- Sums and differences of decimal numbers which are near multiples of 1 or 10, inc. money, e.g. 6.34 + 1.99, £34.59 - £19.95

ADD AND SUBTRACT NUMBERS MENTALLY WITH INCREASINGLY LARGE NUMBERS

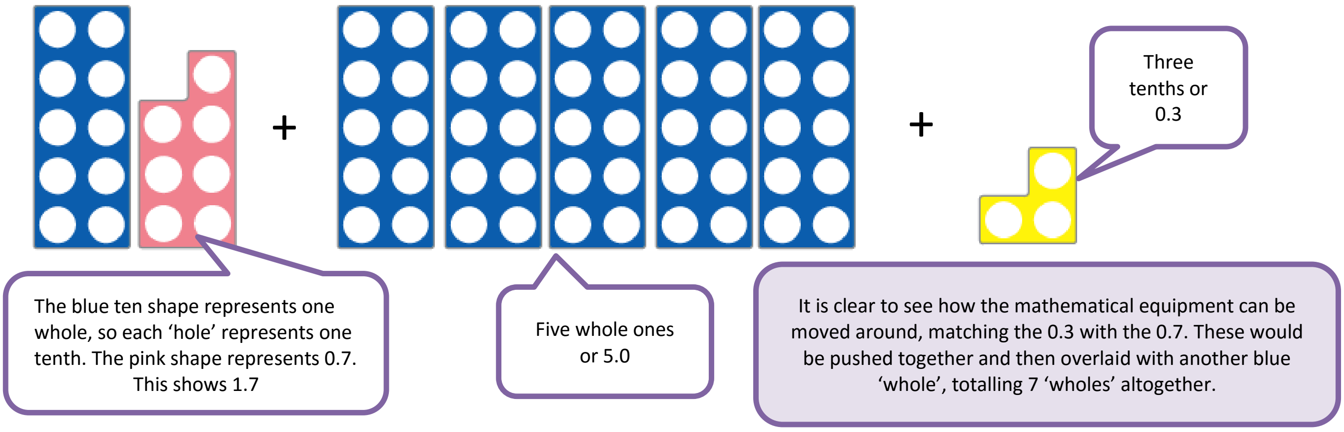
Teaching should focus on:

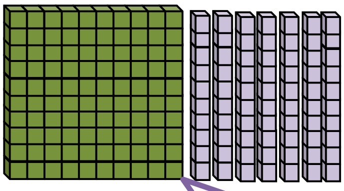
- Encouraging pupils to apply previously taught skills relating to;
    - reordering numbers, e.g. 1.7 + 2.58 + 0.3 should be reordered to 1.7 + 0.3 + 2.58 = 4.58
    - partitioning numbers to support counting on or back, e.g. 4.7- 3.5 = 4.7- 3 – 0.5 = 1.2
    - partitioning to support bridging through multiples of 10, e.g. 6070 – 4987 = 4987 + 13 + 1000 + 70, using jottings as necessary
    - compensating, e.g. 6.58 – 4.9 = 6.58 – 5 + 0.1

As numbers get larger (or smaller than 1) it is crucially important that practical visual resources are still used to model calculations clearly. Pupils need to be encouraged to show their understanding of the mathematics practically, and not fall into the habit of just ‘doing’ the mathematics.

In line with other place value work, they should be confident to represent the numbers being used in a variety of ways; using practical equipment, drawing a diagram or model, using a number line. They can then use these to support them in understanding the strategies being taught.

E.g. 1.7 + 5 + 0.3





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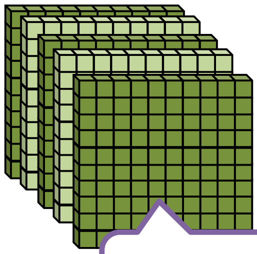

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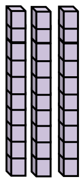


Three purple 'rods' represent three tenths or 0.3

The green 'flat' represents one whole, and so each purple 'rod' represents one tenth. This shows 1.7

Five green 'flats' represents five whole ones or 5

Again the mathematical equipment can be moved around, matching the 0.3 with the 0.7. These would be pushed together and then overlaid with another green 'whole', totalling 7 'wholes' altogether.

+

+

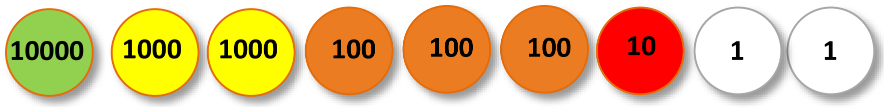
Three 10p coins represent three tenths or 0.3

£1 coin represents 1 'whole', and so each 10p coin represents one tenth. This shows 1.7 or 1.70

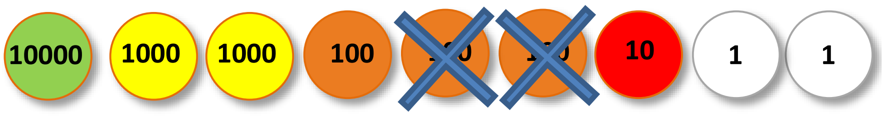
£5 note = 5 'wholes'

Here the pupils need to recognise the VALUE of the equipment as the size of each piece is not representative of its value. They will count ten 10p coins and exchange them for one £1 coin, totalling £7.

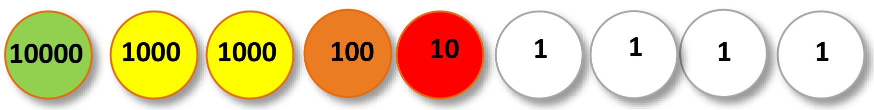
E.g. 12 312 – 198 using a compensation strategy



198 rounded to the nearest 100 = 200
12 312 subtract 200 = 12 112

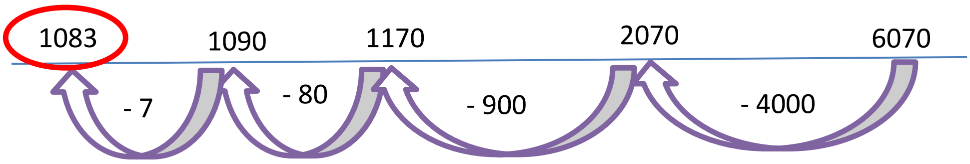


12 112 add 2 = 12 114



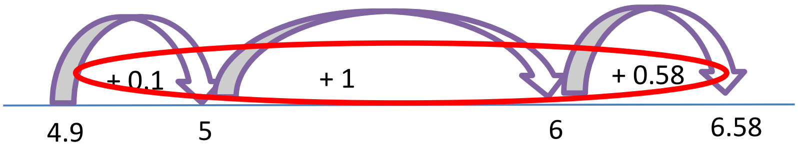
Number lines are a useful tool to model several different mental strategies including ‘bridging’ and ‘compensation’.
E.g. 6070 – 4987

This image uses a ‘bridging’ strategy to show ‘counting up’ (finding the difference) from 4987 to 6070. The answer is shown as the total of the jumps above the line

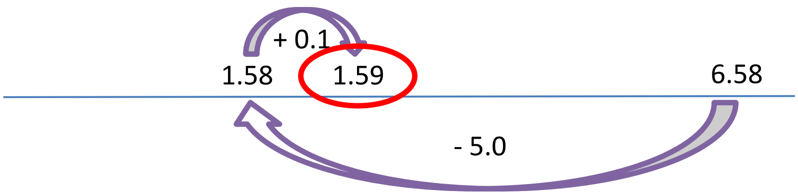


This image uses partitioning skills to show ‘counting back’ (taking away) from 4987 to 6070. The answer is shown on the line as the ‘end point’

E.g. 6.58 – 4.9 could be solved by counting up from 4.9 to 6.58 (finding the difference), or by using a compensation strategy and subtracting 5 before adding 0.1.

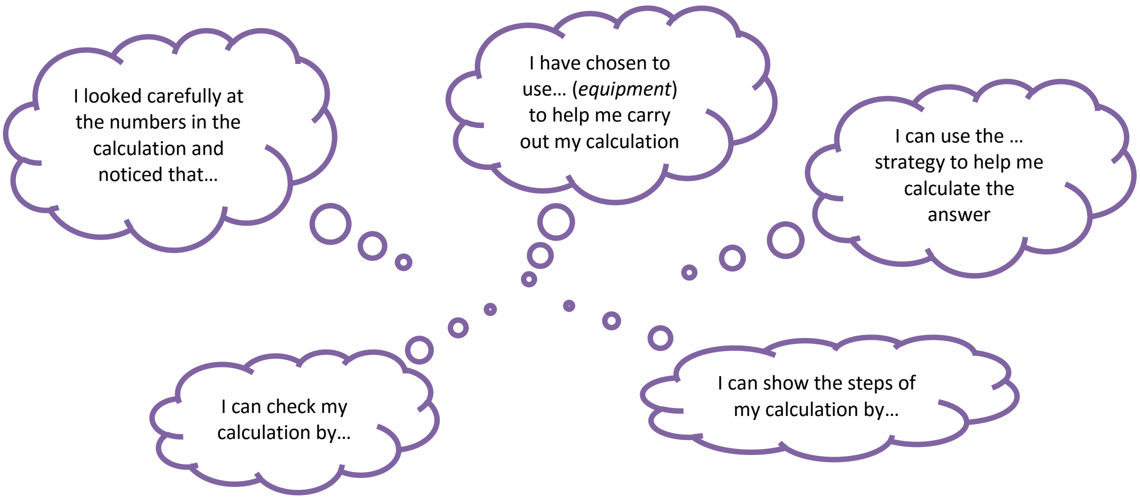


This image uses a ‘bridging’ strategy to show ‘counting up’ (finding the difference) from 4.9 to 6.58
The answer is shown as the total of the jumps above the line.



This image uses a ‘compensation’ strategy to show ‘counting back’ (taking away) 5 from 6.58, then adding 0.1.
The answer is shown as the last number reached on the line.

Pupils should be able to justify their decisions as to the most efficient mental strategies to use for their calculations. Sentence starters are a useful way of supporting pupils when explaining their calculation methods. Examples might include;



USE ROUNDING TO CHECK ANSWERS TO CALCULATIONS AND DETERMINE, IN THE CONTEXT OF A PROBLEM, LEVELS OF ACCURACY

Teaching should focus on:

- Ensuring children have a good understanding of place value for the numbers being used for calculation, i.e. hundredths to hundred thousands
- Positioning numbers on a number line and visually understanding rounding as the closest 100, 1000, 10 000, 100 000, £1, £10 etc.
- Adding and subtracting multiples of 100, 1000, 10 000 etc. to find approximate answers to calculations

Pupils need to understand the purpose of rounding, there is very little point in asking them to round sets of numbers without any context or reason. Rounding is a useful skill for both approximating answers before calculating as well as checking answers to calculations once complete. Pupils should independently choose to use rounding for both of these purposes.

6236 7094 6733 2543 6550

Provide each pupil with a set of five numbers and ask them to order them. Ask a range of questions to practise related place value skills;

- How many of the numbers are divisible exactly by 3?
- Which number is nearest to 6335 on the number line?
- Point to the number that is closest to a multiple of 100
- Point to the number of greatest value
- Order your numbers from largest to smallest. Which is second in the order? Which is the penultimate number in your list?
- Do you have any prime numbers? How do you know?
- Which number has the lowest value?
- Choose one of your number as the 'Odd One Out' – what criteria did you use?

Ask them to place their five numbers on a blank number line, taking into account not only the order of the numbers but the spacing between them.

What values will you mark at the ends of your line?
Which other numbers could you add to your line to make the positioning of your five given numbers easier?
Where will the greatest space be on their number line, between which numbers?
If your five numbers were rounded to the nearest 100, would you still have 5 distinct numbers?
What if they were rounded to the nearest 1000? Why is this?

A meaningful context such as 'athletics' gives pupils the opportunity to practice their estimation and rounding skills, as well as mental calculation strategies. The table below shows the results of four events for five athletes.

	Long jump (m)	High jump (m)	100m (seconds)	200m hurdle (seconds)
Ben	6.54	1.68	10.32	21.32
Pym	5.82	1.59	10.48	21.23
Sarah	6.47	1.63	10.35	20.48
Fleur	6.52	1.55	11.53	19.86
Manjit	5.93	1.49	10.89	20.53

The organisers decide to award points for <u>each event</u> according to position in the group. The athlete in first position will receive 12 points, 10 for second place, 8 for third, 6 for second and 4 points for the athlete in 5th position. They want to know whether they can round the athletes' results for each event, yet still give the same result overall after the points for five events have been taken into account. What do you think? What should they round to? (i.e. nearest metre, tenth of a metre, half metre etc.) What might the potential problems be? Which athlete would be most advantaged by the 'rounding rule'? Can you think of a fairer way of awarding the points?

Create a bank statement and spend some time discussing its format, terms such as 'credit' and 'debit' and overall content.
Design an activity for the children to round the values spent over a given month to a degree of their choice and then find the total. How close is this total to the actual spend total? What if they had rounded to a different degree? Is this a useful strategy to assess how much has been spent? When might they use rounding in their lives?

SOLVE ADDITION AND SUBTRACTION MULTI-STEP PROBLEMS IN CONTEXTS, DECIDING WHICH OPERATIONS TO USE AND WHY

Teaching should focus on:

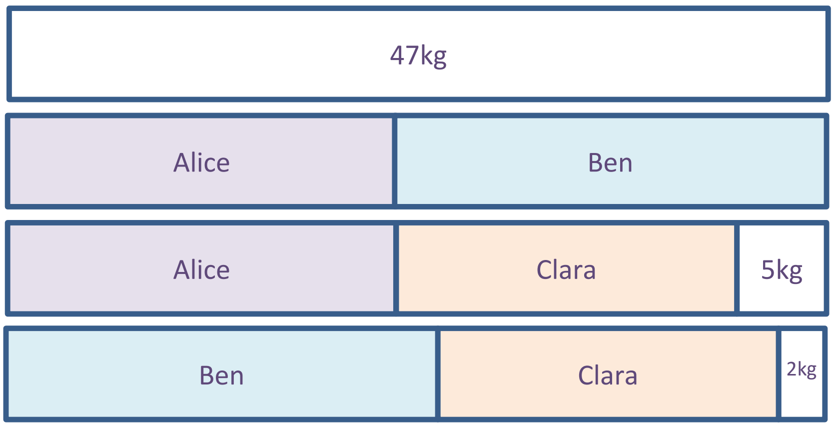
- using and applying their skills of counting, reordering, compensating and knowledge of near doubles
- counting on or back in powers of ten, including tenths and hundredths
- using brackets to accurately record multi-step calculations
- knowing when to 'take away' and when to 'find the difference' when subtracting (***See Year 1 Mental Calculation Guidance for further detail***)
- pupils understanding a given problem and explaining their reasoning in words, using practical equipment and number lines to model their mental calculation strategies

Provide a range of problems and activities, in different contexts, for pupils to practice their taught skills;

When Alice and Ben stand on the scales together, the display reads '47kg'. When Alice and Clara stand on the scales together, they weigh 42kg. When Ben and Clara stand on the scales together, they weigh 45kg.
What would the scales read if all three children stood on the scales together?
What does each child weigh?

Encourage the pupils to discuss different strategies for solving the problem. Suggestions might include drawing a picture or diagram or using 'trial and improvement' skills. E.g. they might estimate a child's weight at 30kg. If Alice is 30kg, then Ben must be 17kg (very light!). If this is the case, then Clara must be 12kg. Ben and Clara must weigh 45kg between them and with these values, they only weigh 29kg – this is too light. Pupils can use this 'trial' and improve their initial estimate for Alice's weight, making her lighter, e.g. 25kg.

The 'Bar Model' can be an effective way of laying out the problem, to support the children in 'seeing the mathematics' embedded in the information given.



The diagram clearly shows that Ben weighs 5kg more than Clara. If this information is substituted into the bottom bar of the diagram;

It is now clear that Clara + Clara + 7kg = 47kg. Therefore double Clara's weight = 40kg, so Clara weighs 20kg. If this is the case, then the main bar model diagram can be used to find Alice's weight (22kg) and Ben's weight (25kg).

Concert Tickets
An open air concert was attended by 2569 people. The organisers had sold 1360 adult tickets, 226 children's tickets and the rest were sold to students. How many students could have attended the concert? If they actually sold 1108 student tickets, how many people (who had bought tickets) did not attend the concert?

Towns
Bubbletown has 6718 inhabitants, which is 2576 less than Sudsville has. If 1289 people move from Sudsville to Bubbletown, which town will have more inhabitants? How many more?

Money Matters
Mr Clean bought a washing machine for £521 and a tumble dryer for £278 less. He gave the cashier £800 cash. How much change should he have received?

Helen had £3600 in her bank account and George had £2920. They each earned another £1500. Who has more money now? How much more?

Uncle Jack had £5400 and Auntie Molly had £4500. They each spend £1700. Who has more money left and how much more?

Pupils should be encouraged to clearly show the calculations they have used and explain any choices and decisions made. Could they have made this easier? Encourage them to estimate their answers before calculating and then use different strategies to check answers. By this stage they should be able to explain their work in writing, using appropriate mathematical vocabulary.

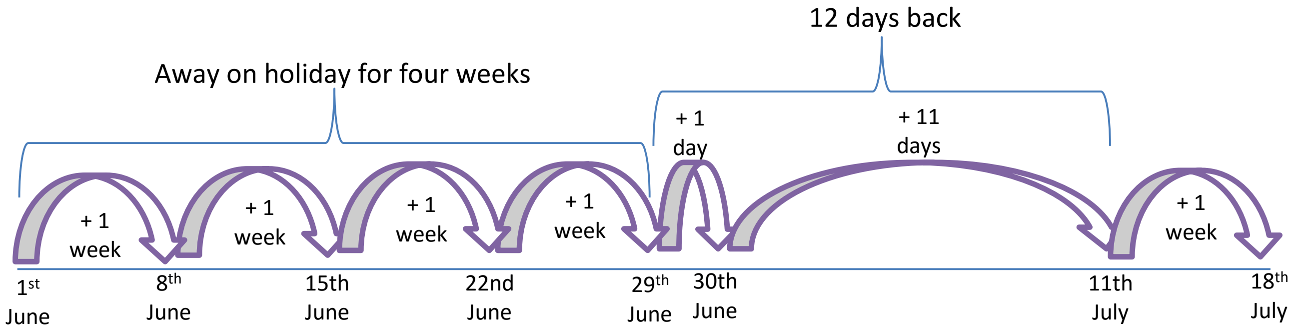
SOLVE PROBLEMS INVOLVING CONVERTING BETWEEN UNITS OF TIME

Teaching should focus on:

- learning time-related facts and equivalences, e.g. 60 seconds = 1 minute, 60 minutes = 1 hour, 24 hours = 1 day, 7 days = 1 week, 52 weeks = 1 year, 365 days = 1 year (non-leap), 366 days = 1 leap year, as well as the number of days in each month of the year.
- use partitioning when counting on or back in seconds, minutes or hours, bridging through 60 to solve problems in the context of time

Sam works in an office, working Monday to Friday. He decided to take four weeks holiday from work, starting on Monday 1st June. After his holiday he had 12 days until it was exactly one week until his birthday. What date is his birthday?

Encourage pupils to use a number (time) line to record their calculations, e.g.



How old?

Daniel, who is in Year 5, says that he is more than five million minutes old. Can he be correct? How do you know?

It is the 3rd April. Kate says it will be her birthday in 8640 minutes. What date is her birthday?

Encourage pupils to show their working out, either through clearly annotated, detailed calculations or through the use of visual models such as a number line.
What other challenges can they set for each other requiring conversion between seconds, minutes, hours, days, weeks etc?

Conversion of time

1000 milliseconds = 1 second
60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
30 days in Sep, Apr, Jun, Nov
31 days in Jan, Mar, May, Jul, Aug, Oct, Dec
28 days in Feb (29 in leap year)
365 days = 1 year (366 in leap year)
10 years = 1 decade
100 years = 1 century