National Curriculum Programme of Study:

- count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000.
- multiply and divide numbers mentally drawing upon known facts.
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000.
- solve problems involving multiplication and division including using their knowledge of factors and multiples, squares and cubes.
- solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign.
- solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates.

MENTAL CALCULATION
Multiplication & Division

FLUENCY

By the end of Year 5, children should fluently recall:

- Factor pairs for 2 digit numbers
- Prime numbers up to 19 and establish prime numbers to 100
- Square numbers to 12 x 12 and cube numbers to at least 5^3
- Place value and multiplication facts to derive multiplication and division facts involving decimals.

FORWARDS OR BACKWARDS IN STEPS OF POWERS OF 10 FOR ANY GIVEN NUMBER UP TO 1 000 000

Teaching should focus on:

- Counting forwards and backwards in steps of powers of 10

- The counting stick can be considered as part of a continuous or 'empty number line' with clearly marked intervals along the stick to represents specific points. Progressing from activities in Year 4, pupils can focus on counting on and back in steps of 10, 100, 1000, 10 000, 100 000 and 1 000 000. These activities can also be adapted to count on and back in tenths, hundredths and so on.

When counting on in 10,000s, make the beginning of the stick any number, for example 1683. Count along the stick in 1000s from this number. What patterns do the children notice? Which digits change? Which digits stay the same? Try using different starting points such as 5, 109, 1013. Ask a pupil to record the numbers counted and focus on the writing of the numbers, "How do we write 10,109?. "Ask, "If this point is 18 650 and we are counting on in 10 000s, what number would this be (point to an interval at a different point on the stick)?" Repeat counting on and back in different powers of 10.

If zero is at one end and 100 000 at the other, what is each interval worth? Point to the interval in the centre of the stick, if this number is 25 750 what numbers could come either side? At the start and at the end of the stick? Encourage pupils to use their knowledge of counting on and back in powers of 10 to decide on a range of possibilities for the steps. Can other pupils decide which steps are being taken?

- Provide number sequences to stimulate discussion such as
  - Here is part of a number sequence 180 500, 190 500, 200 500, 210 500. The number 60 500 will appear in this sequence, true or false?
  - What is wrong with this sequence of numbers?
    58 762, 59 762, 61 762, 62 762
  - How can you work out the missing numbers in this sequence?
    4000, 7000, ☐, 13 000, ☐, 19 000

MULTIPLY AND DIVIDE NUMBERS MENTALLY DRAWING UPON KNOWN FACTS

Teaching should focus on:

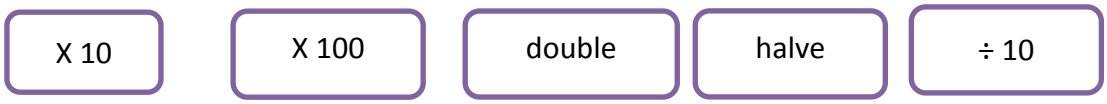
- Doubling and halving strategies
- Multiplying and dividing by powers of 10

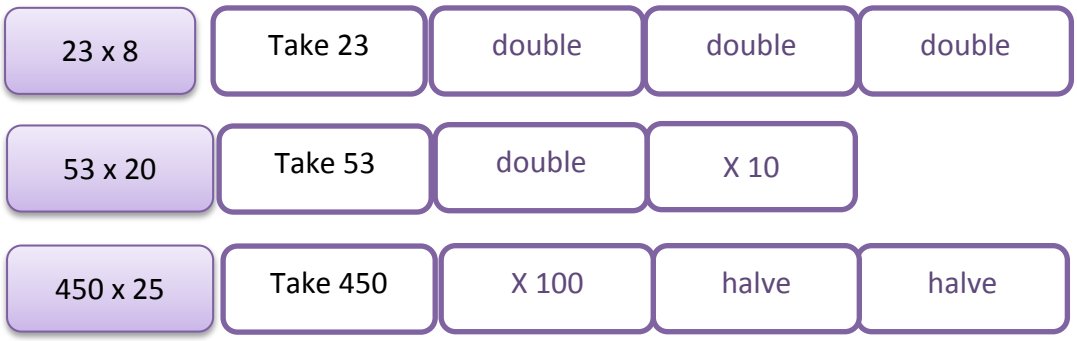
See also **Year 5** ***Written Calculation Guidance for Multiplication and Division***

- Show pupils a list of calculations for discussion. How many different ways can they think of to solve each equation? Which mental calculation strategy is the most efficient? Would they use a written method for any of the calculations? For example

34 x 4	104 ÷ 4	23 x 8
152 x 9	450 x 25	218 x 5
26 x 50	112 ÷ 8	240 ÷ 20
146 x 1.5	53 x 20	168 ÷ 3

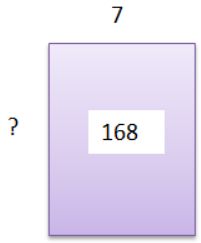
- To support the above activity, pupils could be provided with prompt cards. For example,



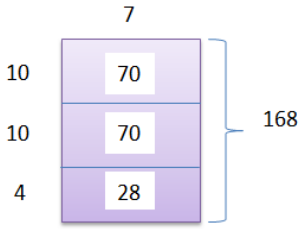


- Building upon chunking/ grouping division work in year 4, pupils can continue using this knowledge to solve problems.

168 ÷ 7



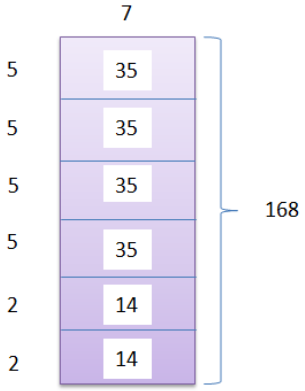
Encourage pupils to draw a diagram/ an array to represent the division question.



Ask pupils to draw in blocks, showing chunks of the divisor.
In the diagram on the left, the 168 is made up from
70 + 70 + +28.

In the diagram on the right, the 168 is made up from
35 + 35 + 35 + 35 + 14 + 14.

Both diagrams show that
168 ÷ 7 = 24



MULTIPLY AND DIVIDE WHOLE NUMBERS AND THOSE INVOLVING DECIMALS BY 10, 100 AND 1000

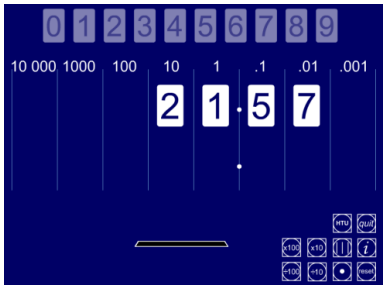
Teaching should focus on:

- What happens to the digits in a number when it is multiplied or divided by 10, 100 and 1000
- Exploring the value of each digit as the number becomes 10 times larger or smaller
- Using known facts to derive new facts

- Give each pair of pupils a place value grid (shown below), some digit cards and a set of zero cards. Ask them to make the number 32.6 with their cards, placing them in the appropriate spaces in the grid. Ask them to make the number 10 times bigger and explain to their partner what is happening to the digits. Make the number 100 times bigger. What happens to the digits when they make it 10 times smaller. Ask the pupils to continue making their own starting numbers and multiplying and dividing it by 10, 100 and 1000. Are there any numbers that are difficult to multiply and divide? Why?

HTh	Th	H	T	U	.	t	h
10 000	1000	100	10	1	.	10th	100th
			3	2	.	6	

The interactive teaching programme ‘Moving Digits’ also provides an interactive demonstration.

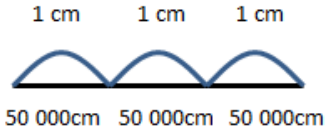


- Provide some problem solving opportunities including questions such as

  The product is 600. At least one of the numbers is a multiple of 10. What two numbers could have been multiplied together? Are there any other possibilities?

  6 x 8 = 48. Explain how you can use this fact to solve the following equations.
  0.6 x 0.8 =
  4.8 ÷ 8 =

  The scale of a map is 1:50 000
  A distance is measured as 3cm on the map. How many cm, m and km is this equivalent to in real life? Encourage pupils to make jottings and draw diagrams to support their thinking.



150 000cm = 1500m
1500m = 1.5 km

SOLVE PROBLEMS INVOLVING

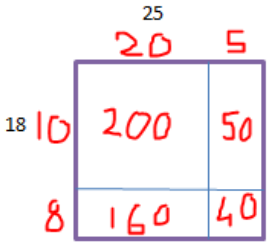
- MULTIPLICATION AND DIVISION INCLUDING USING THEIR KNOWLEDGE OF FACTORS AND MULTIPLES, SQUARES AND CUBES
- ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION AND A COMBINATION OF THESE, INCLUDING UNDERSTANDING THE MEANING OF THE EQUALS SIGN
- MULTIPLICATION AND DIVISION, INCLUDING SCALING BY SIMPLE FRACTIONS AND PROBLEMS INVOLVING SIMPLE RATES.

Teaching should focus on solving problems using:

- Mental calculation strategies for multiplication and division
- Knowledge of factors, multiples, squares and cubes
- Scaling by simple fractions
- Simple rates

See also **Year 5** ***Written Calculation Guidance for Multiplication and Division***

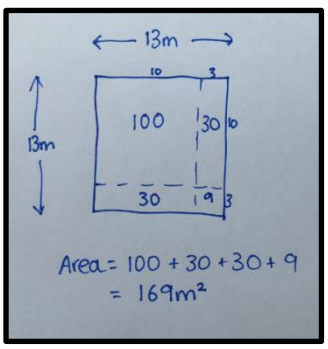
- Extend pupils knowledge of use of arrays to calculating with larger numbers. For example



$200 + 50 + 160 + 40 = 450m^2$

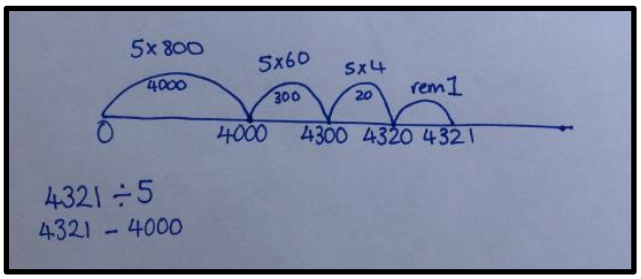
Mr Connors had a square garden with a perimeter of 52m.

What was the area of the garden?

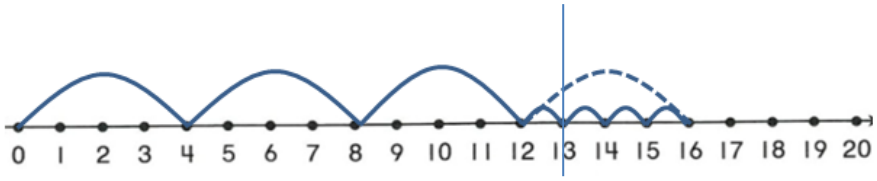


- Continue developing grouping/ chunking strategies to support mental division strategies. Using table facts encourage pupils to use the largest, most efficient groups/ chunks. Jottings to support mental calculations could include the use of empty number lines or calculations sentences.

4321 ÷ 5



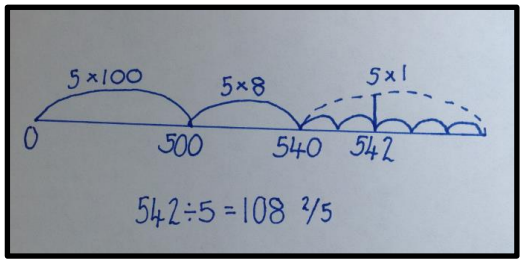
- Using the number line, pupils can see how to interpret remainders into fractions or decimal equivalents. For example, using a simple calculation such as **13 ÷ 4** to demonstrate



13 ÷ 4 = 3 rem 1

The remainder 1 is actually ¼ of the next jump of 4, so the answer could be written as

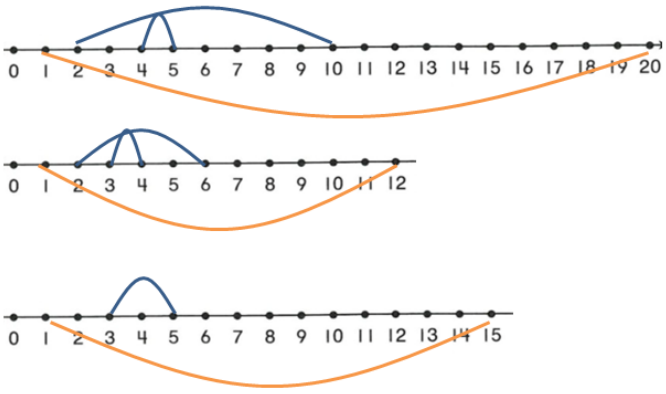
13 ÷ 4 = 3 ¼ or 3.25



542 ÷ 5

- In order to investigate factors and prime numbers, pupils could play this game. Player A takes a small handful of counters and arranges them into an array, if possible. Arrays have to be more than a single line. Player A records the array as 2 multiplication sentences, if both players are in agreement, player A scores 1 point. Player B rearranges counters into another array if possible and records the related multiplication sentences, if both players are in agreement with the array, player B gets a point. Play continues until no further arrays can be made. Another set of counters are taken. Look at the factors for each set of counters. Which sets of counters could only be arranged in a single line? Explain that these are called prime numbers.

- Ask pupils to link up factor pairs of a given number on a number line. What patterns do they notice? What is the largest possible factor of any number other than itself? What does the number line look like for a prime number?

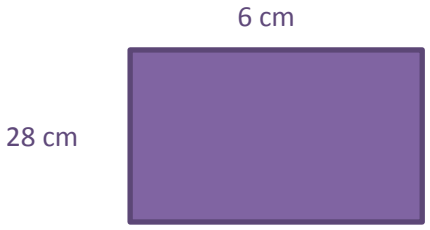


- By fluently recalling factor pairs, pupils can construct equivalent statements to solve multiplication questions. For example

6 x 35 = 2 x 3 x 35 = 2 x 35 x 3
2 x 35 = 70
70 x 3 = 210

3 x 270 = 3 x 3 x 9 x 10
= 9 x 90
=810

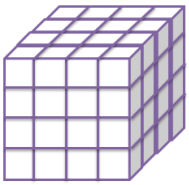
Link using this strategy to other areas of the mathematics curriculum such as calculating area. For example,



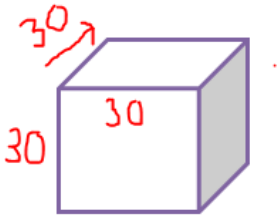
28 x 6
= 14 x 2 x 6
= 7 x 2 x 2 x 6
= 7 x 6 x 4
= 42 x 4 (double and double)
= 168

- Look at models which represent and demonstrate how cube numbers are created. Create a 4 x 4 layer of multilink cubes and then make 3 more. If we stand them on top of each other we have four sets of layers which are 4 x 4.

If one layer is 16 cubes, 4 layers will be 16 x 4 (or 4 x 4 x 4 = $4^{3)}$



Jacob has a cube shaped box which is 30cm long. How much space will it take up?

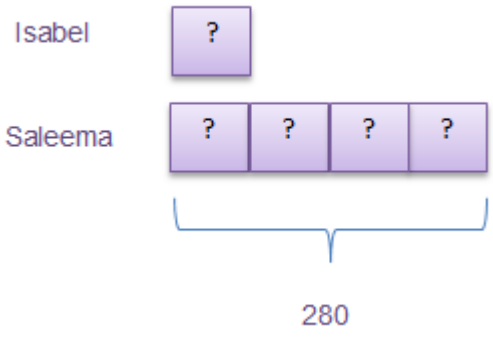


30 x 30 x 30 or 30^3
30 x 30 = 900
900 x 30 = 27000

= 27000 cm^3

- Bar model representations are particularly helpful in representing problems such as;

Saleema and Isabel have a collection of stickers. Saleema has 4 times as many as Isabel. Saleema has 280 stickers. How many stickers do they have altogether?



Isabel has an amount of stickers.

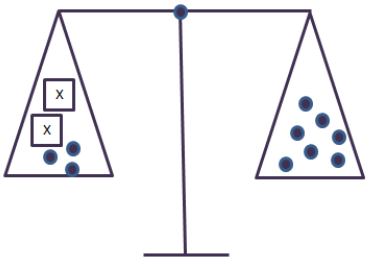
Saleema has 4 times this amount.

Saleema has 280 stickers.

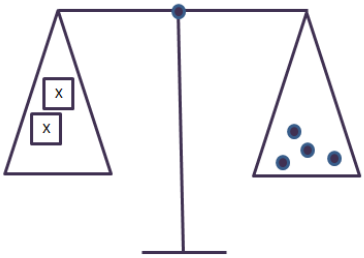
Isabel's amount will be the same as 280 ÷ 4
Each bar is worth 70.
Therefore they will have
70 x 5 = 350 stickers altogether.

- Give the children algebraic type problems that involve balancing to help them understand the meaning of the equals sign.

2x + 3 = 7, what is the value of x?



Take 3 from each side



This leaves 2x = 4
Halve each side
Leaving x = 2