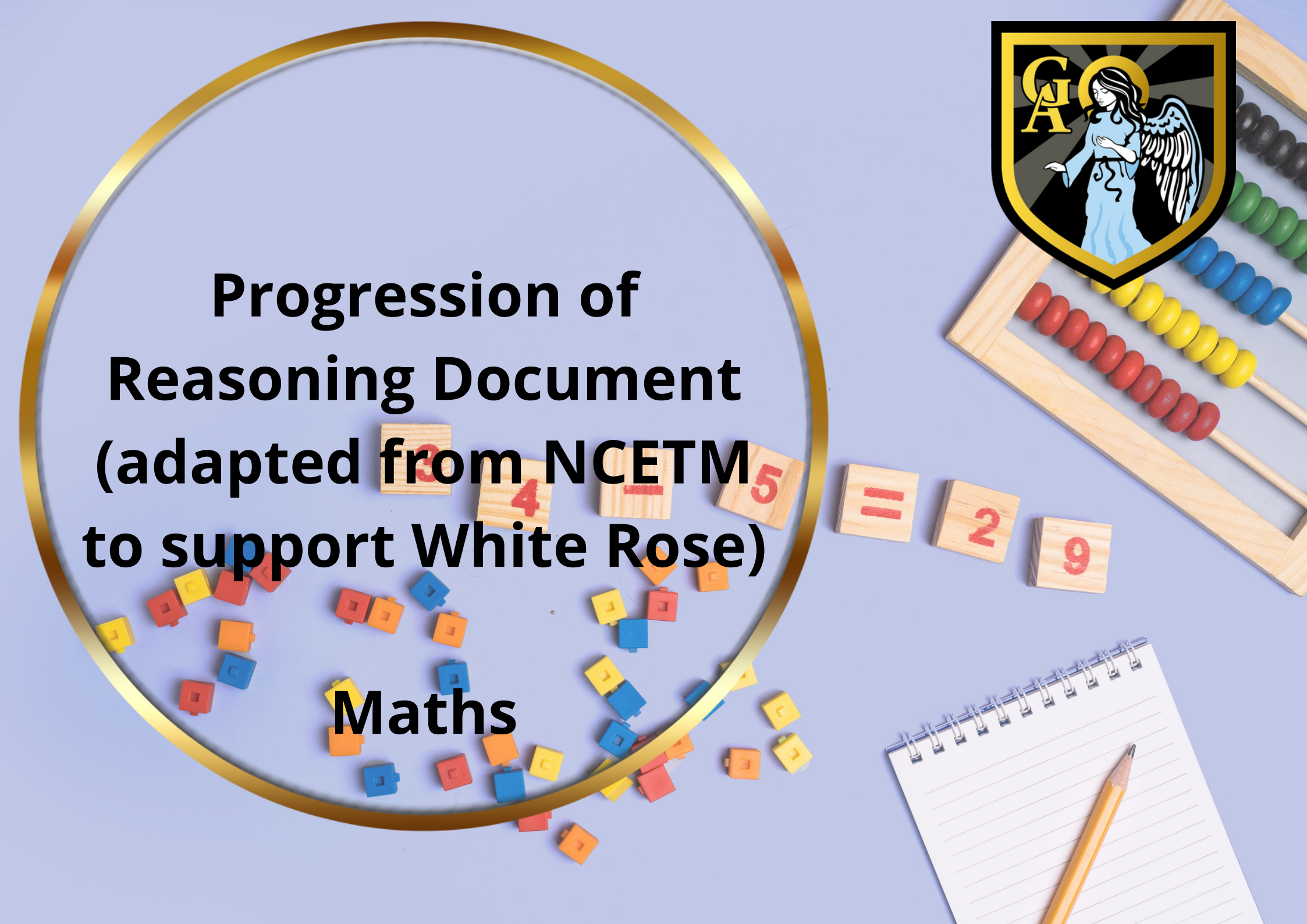
Progression of Reasoning Document (adapted from NCETM to support White Rose)

Maths



Place Value: Count

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Spot the mistake: 5,6,8,9 What is wrong with this sequence of numbers? True or False? I start at 2 and count in twos. I will say 9 What comes next? 10+1 = 11 11+1= 12 12+1 = 13	Spot the mistake: 45,40,35,25 What is wrong with this sequence of numbers? True or False? I start at 3 and count in threes. I will say 13? What comes next? 41+5=46 46+5=51 51+5=56	Spot the mistake: 50,100,115,200 What is wrong with this sequence of numbers? True or False? 38 is a multiple of 8? What comes next? 936-10= 926 926 -10 = 916 916- 10= 906	Spot the mistake: 950, 975,1000,1250 What is wrong with this sequence of numbers? True or False? 324 is a multiple of 9? What comes next? 6706+ 1000= 7706 7706 + 1000 = 8706 8706 + 1000 = 9706	Spot the mistake: 177000,187000,197000,217000 What is wrong with this sequence of numbers? True or False? When I count in 10's I will say the number 10100? What comes next? 646000-10000= 636000 636000 –10000 = 626000 626000-10000 = 616000	Spot the mistake: -80,-40,10,50 What is wrong with this sequence of numbers? True or False? When I count backwards in 50s from 10 I will say -200 True or False? The temperature is -3. It gets 2 degrees warmer. The new temperature is 5?

Place Value: Use and Compare

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Do, then explain Look at the objects. (in a collection). Are there more of one type than another? How can you find out?	Do, then explain 37 13 73 33 3 If you wrote these numbers in order starting with the smallest, which number would be third? Explain how you ordered the numbers	Do, then explain 835 535 538 388 508 If you wrote these numbers in order starting with the smallest, which number would be third? Explain how you ordered the numbers.	Do, then explain 5035 5053 5350 5530 5503 If you wrote these numbers in order starting with the largest, which number would be third? Explain how you ordered the numbers.	Do, then explain 747014 774014 747017 774077 744444 If you wrote these numbers in order starting with the smallest, which number would be third? Explain how you ordered the numbers.	Do, then explain Find out the populations in five countries. Order the populations starting with the largest. Explain how you ordered the countries and their populations.

Place Value: Place Value

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Do, then explain Show the value of the digit 2 in these numbers? 32 27 92 Explain how you know.	Do, then explain Show the3 value of the digit 3 in these numbers? 341 503 937 Explain how you know	Do, then explain Show the value of the digit 4 in these numbers? 3041 4321 5497 Explain how you know.	Do, then explain Show the value of the digit 5 in these numbers? 350114 567432 985376 Explain how you know.	Do, then explain Show the value of the digit 6 in these numbers? 6787555 95467754 Expalin how you know.

Place Value: Rounding

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
			Possible answers A number rounded to the nearest ten is 540. What is the smallest possible number it could be? What do you notice? Round 296 to the nearest 10. Round it to the nearest 100. What do you notice? Can you suggest other numbers like this?	Possible answers A number rounded to the nearest thousand is 76000 What is the largest possible number it could be? What do you notice? Round 343997 to the nearest 1000. Round it to the nearest 10000. What do you notice? Can you suggest other numbers like this?	Possible answers Two numbers each with two decimal places round to 23.1 to one decimal place. The total of the numbers is 46.2. What could the numbers be? What do you notice? Give an example of a six digit number which rounds to the same number when rounded to the nearest 10000 and 100000

Addition and Subtraction: Number Bonds

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Continue the pattern 10 + 8 = 18 11 + 7 = 18 Can you make up a 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 space?	Continue the pattern 90 = 100 – 10 80 = 100 – 20 Can you make up a similar pattern starting with the numbers 74, 26 and 100? Missing numbers 91 + = 100 100 - = 89 What number goes in the missing space?				

Addition and Subtraction: Mental Calculation

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
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 – 10 = 1 Can you make up some other number sentences like this involving 3 different numbers?	True or false? Are these number sentences 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 the hard questions are hard?	True or false? Are these number sentences true or false?597 + 7 = 614 804 – 70 = 744 768 + 140 = 908 Give your reasons. Hard and easy questions Which questions are easy / hard? 323 + 10 = 393 + 10 = 454 - 100 = 954 - 120 = Explain why you think the hard questions are hard?	True or false? Are these number sentences true or false?6.7 + 0.4 = 6.11 8.1 – 0.9 = 7.2 Give your reasons. Hard and easy questions Which questions are easy / hard? 13323 - 70 = 12893 + 300 = 19354 - 500 = 19954 + 100 = Explain why you think the hard questions are hard?	True or false? Are these number sentences true or false?6.17 + 0.4 = 6.57 8.12 – 0.9 = 8.3 Give your reasons. Hard and easy questions Which questions are easy / hard? 213323 - 70 = 512893 + 300 = 819354 - 500 = 319954 + 100 = Explain why you think the hard questions are hard?	True or false? Are these number sentences true or false?6.32 + = 8 = 1.68 Give your reasons. Hard and easy questions Which questions are easy / hard? 213323 - 70 = 512893 + 37 = 8193.54 - 5.9 = Explain why you think the hard questions are hard?

Addition and Subtraction: Written Methods

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Convince me In my head I have two odd numbers with a difference of 2. What could they be? Convince me Missing numbers Fill in the missing numbers (using a range of practical resources to support) 12 + = 19 20 - = 3	Convince me What digits could go in the boxes? 7 - 2 = 46 Try to find all of the possible answers. How do you know you have got them all? Convince me	Convince me + + The total is 201 Each missing digit is either a 9 or a 1. Write in the missing digits. Is there only one way of doing this or lots of ways? Convince me	Convince me ___- 666 = 8_ 5 What is the largest possible number that will go in the rectangular box? What is the smallest? Convince me	Convince me _____+ 1475 =6_24 What numbers go in the boxes? What different answers are there? Convince me	Convince me Three four digit numbers total 12435. What could they be? Convince me

Addition and Subtraction: Inverse Operation and Estimating

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Making an estimate Pick (from a selection of number sentences) the ones where the answer is 8 or 9. Is it true that? Is it true that 3+4 = 4 + 3?	Making an estimate Which of these number sentences 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 add three numbers less than 10 the answer will be an odd number	Making an estimate Which of these number sentences have the answer that is between 50 and 60 174 - 119 333 – 276 932 - 871 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	Making an estimate Which of these number sentences have the answer that is between 550 and 600 1174 - 611 3330 – 2779 9326 - 8777 Always, sometimes, never Is it always sometimes or never true that the difference between two odd numbers is odd	Making an estimate Which of these number sentences have the answer that is between 0.5 and 0.6 11.74 - 11.18 33.3 – 32.71 Always, sometimes, never Is it always, sometimes or never true that the sum of four even numbers is divisible by 4.	Making an estimate Circle the number that is the best estimate to 932.6 - 931.05 1.3 1.5 1.7 1.9 Always, sometimes, never Is it always, sometimes or never true that the sum of two consecutive triangular numbers is a square number

Multiplication and Division: Facts

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	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?	Missing numbers 24 = x Which pairs of numbers could be written in the boxes? Making links Cards come in packs of 4. How many packs do I need to buy to get 32 cards	Missing numbers 72 = x Which pairs of numbers could be written in the boxes? Making links Eggs are bought in boxes of 12. I need 140 eggs; how many boxes will I need to buy?	Missing numbers 6 x 0.9 = x 0.03 6 x 0.04 = 0.008 x Which numbers could be written in the boxes? Making links Apples weigh about 170 g each. How many apples would you expect to get in a 2 kg bag?	Missing numbers 2.4 ÷ 0.3 = x 1.25 Which number could be written in the box?

Multiplication and Division: Mental Calculations

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
		Use a fact 20 x 3 = 60. Use this fact to work out 21 x 3 = 22 x 3 = 23 x 3 = 24 x 3 =	Use a fact 63 ÷ 9 = 7 Use this fact to work out 126 ÷ 9 = 252 ÷ 7	Use a fact 3 x 75 = 225 Use this fact to work out 450 ÷ 6 = 225 ÷ 0.6 = To multiply by 25 you multiply by 100 and then divide by 4. Use this strategy to solve 48 x 25 78 x 25 4.6 x 25	Use a fact 12 x 1.1 = 13.2 Use this fact to work out 15.4 ÷ 1.1 = 27.5 ÷ 1.1 =

Multiplication and Division: Written Calculations

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Prove It Which four number sentences link these numbers? 3, 5, 15? Prove it.	How close can you get? _ _ × _ Using the digits 2, 3 and 4 in the calculation above how close can you get to 100? What is the largest product? What is the smallest product?	How close can you get? _ _ _ X 7 Using the digits 3, 4 and 6 in the calculation above how close can you get to 4500? What is the largest product? What is the smallest product?	Prove It What goes in the missing box? 12_2 ÷ 6 = 212 14_4 ÷ 7 = 212 22_3 ÷ 7 = 321 r 6 Prove it	Can you find? Can you find the smallest number that can be added to or subtracted from 87.6 to make it exactly divisible by 8/7/18?

Multiples, Primes, Squares, Factors

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Spot the mistake Use a puppet to count but make some deliberate mistakes. e.g. 2 4 5 6 10 9 8 6 See if the pupils can spot the deliberate mistake and correct the puppet	True or false? When you count up in tens starting at 5 there will always be 5 units	True or false? All the numbers in the two times table are even. There are no numbers in the three times table that are also in the two times table.	Always, sometimes, never? Is it always, sometimes or never true that an even number that is divisible by 3 is also divisible by 6. Is it always, sometimes or never true that the sum of four even numbers is divisible by 4.	Always, sometimes, never? Is it always, sometimes or never true that multiplying a number always makes it bigger Is it always, sometimes or never true that prime numbers are odd. Is it always, sometimes or never true that when you multiply a whole number by 9, the sum of its digits is also a multiple of 9	Always, sometimes, never? Is it always, sometimes or never true that dividing a whole number by a half makes the answer twice as big. Is it always, sometimes or never true that when you square an even number, the result is divisible by 4 Is it always, sometimes or never true that multiples of 7 are 1 more or 1 less than prime numbers.

Fractions: Counting

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Spot the mistake 7, 7 ½ , 8, 9, 10 8 ½, 8, 7, 6 ½, ... and correct it	Spot the mistake six tenths, seven tenths, eight tenths, nine tenths, eleven tenths ... and correct it.	Spot the mistake sixty tenths, seventy tenths, eighty tenths, ninety tenths, twenty tenths ... and correct it.	Spot the mistake 0.088, 0.089, 1.0	Spot the mistake Identify and explain mistakes when counting in more complex fractional steps

Fractions: Recognising Fractions

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
What do you notice? Choose a number of counters. Place them onto 2 plates so that there is the same number on each half. When can you do this and when can't you? What do you notice	What do you notice? ¼ of 4 = 1 ¼ of 8 = 2 ¼ of 12 = 3 Continue the pattern What do you notice?	What do you notice? 1/10 of 10 = 1 2/10 of 10 = 2 3/10 of 10 = 3 Continue the pattern. What do you notice? What about 1/10 of 20? Use this to work out 2/10 of 20, etc.	What do you notice? 1/10 of 100 = 10 1/100 of 100 = 1 2/10 of 100 = 20 2/100 of 100 = 2 How can you use this to work out 6/10 of 200? 6/100 of 200?	What do you notice? One tenth of £41 One hundredth of £41 One thousandth of £41 Continue the pattern What do you notice? 0.085 + 0.015 = 0.1 0.075 + 0.025 = 0.1 0.065 + 0.035 = 0.1 Continue the pattern for the next five number sentences	What do you notice? One thousandth of my money is 31p. How much do I have

Comparing Decimals

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
			What needs to be added to 3.23 to give 3.53? What needs to be added to 3.16 to give 3.2?	What needs to be added to 3.63 to give 3.13? What needs to be added to 4.652 to give 4.1?	What needs to be adde3d to 6.543 to give 7? What needs to be added to 3.582 to give 5? Circle the two decimals which are closest in value to each other. 0.9 0.09 0.99 0.1 0.01

Decimals: Roundng

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
			Do, then explain Circle each decimal which when rounded to the nearest whole number is 5 5.3 5.7 5.2 5.8 Explain your reasoning Top tips Explain how to round numbers to one decimal place? Also see rounding in place value	Do, then explain Circle each decimal which when rounded to one decimal place is 6.2. 6.32 6.23 6.27 6.17 Explain your reasoning Top tips Explain how to round decimal numbers to one decimal place? Also see rounding in place value	Do, then explain Write the answer of each calculation rounded to the nearest whole number 75.7 × 59 7734 ÷ 60 772.4 × 9.7 20.34 × (7.9 – 5.4) What's the same, what's different? ... when you round numbers to one decimal place and two decimal places? Also see rounding in place value

Eqivalence: Fractions, Decimals and Percentages

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Odd one out. Which is the odd one out in this trio: ½ 2/4 ¼ Why? What do you notice? Find ½ of 8. Find 2/4 of 8 What do you notice?	Odd one out. Which is the odd one out in each of these trios ½ 3/6 5/8 3/9 2/6 4/9 Why? What do you notice? Find 2/5 of 10 Find 4/10 of 10. What do you notice? Can you write any other similar statements?	Odd one out. Which is the odd one out in each of these trio s¾ 9/12 4/6 9/12 10/15 2/3 Why? What do you notice? Find 4/6 of 24 Find 2/3 of 24 What do you notice? Can you write any other similar statements	Odd one out. Which is the odd one out in each of these collections of 4 fractions 6/10 3/5 18/20 9/15 30/100 3/10 6/20 3/9 Why? What do you notice? Find 30/100 of 200 Find 3/10 of 200 What do you notice? Can you write any other similar statements?	Odd one out. Which is the odd one out in each of these collections of 4 fraction s¾ 9/12 26/36 18/24 4/20 1/5 6/25 6/30 Why? What do you notice? 8/5 of 25 = 40 5/4 of 16 = 20 7/6 of 36 - 42 C an you write similar statements?

Fractions: Addition and Subtraction

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
		What do you notice? 1/10 + 9/10 = 1 2/10 + 8/10 = 1 3/10 + 7/10 = 1	What do you notice? 5/5 – 1/5 = 4/5 4/5 – 1/5 = 3/5	What do you notice? ¾ and ¼ = 4/4 = 1 4/4 and ¼ = 5/4 = 1 ¼ 5/4 and ¼ = 6/4 = 1 ½ Continue the pattern up to the total of 2.	Another and another Write down two fractions which have a difference of 1 2/... and another, ... and another, ...

Fractions: Multiplication and Division

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
			Undoing I divide a number by 100 and the answer is 0.3. What number did I start with? Another and another Write down a number with one decimal place which when multiplied by 10 gives an answer between 120 and 130. ... and another, ... and another,	Undoing I divide a number by 100 and the answer is 0.33 What number did I start with? Another and another Write down a number with two decimal places which when multiplied by 100 gives an answer between 33 and 38. ... and another, ... and another, ...	Undoing I multiply a number with three decimal places by a multiple of 10. The answer is approximately 3.21 What was my number and what did I multiply buy? When I divide a number by 1000 the resulting number has the digit 6 in the units and tenths and the other digits are 3 and 2 in the tens and

Ratio and Proportion

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
					What else do you know? In a flower bed a gardener plants 3 red bulbs for every 4 white bulbs. How many red and white bulbs might he plant? If she has 100 white bulbs, how many red bulbs does she need to buy? If she has 75 red bulbs, how many white bulbs does she need to buy? If she wants to plant 140 bulbs altogether, how many of each colour should she buy? Do, then explain Purple paint is made from read and blue paint in the ratio of 3:5. To make 40 litres of purple paint how much would I need of each colour? Explain your thinking.

Fractions and Percentages of Amount

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
					What else do you know? 88% of a sum of money = £242. Make up some other statements. Write real life problems for your number sentences. Undoing I think of a number and then reduce it by 15%. The number I end up with is 306. What was my original number? In a sale where everything is reduced by 15% I paid the following prices for three items. £255, £850, £4.25 What was the original selling price?

Measurement

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Top tips How do you know that this (object) is heavier / longer / taller than this one? Explain how you know.	Top tips Put these measurements in order starting with the smallest. 75 grammes 85 grammes 100 grammes Explain your thinking	Top Tips Put these measurements in order starting with the largest. Half a litre Quarter of a litre 300 ml Explain your thinking	Top Tips Put these amounts in order starting with the largest. Half of three litres Quarter of two litres 300 ml Explain your thinking	Top Tips Put these amounts in order starting with the largest. 130000cm2 1.2 m2 13 m2 Explain your thinking	Top Tips Put these amounts in order starting with the largest. 100 cm3 1000000 mm3 1 m3 Explain your thinking

Measure

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Draw two lines whose lengths differ by 4cm.	Write more statements (You may choose to consider this practically) If there are 630ml of water in a jug. How much water do you need to add to end up with a litre of water?	Write more statements One battery weighs the same as 60 paperclips; One pencil sharpener weighs the same as 20 paperclips. Write down some more things you know.	Write more statements Mr Smith needs to fill buckets of water. A large bucket holds 6 litres and a small bucket holds 4 litres. If a jug holds 250 ml and a bottle holds 500 ml suggest some ways of using the jug and bottle to fill the buckets.	Write more statements Chen, Megan and Sam have parcels. Megan's parcel weighs 1.2kg and Chen's parcel is 1500g and Sam's parcel is half the weight of Megan's parcel. Write down some other statements about the parcels. How much heavier is Megan's parcel than Chen's parcel?

Time

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Working backwards Draw hands on the clock faces to show when break started and when it finished 15 minutes later at 10:35.	Working backwards Tom's bus journeytakes half an hour. He arrives at his destination at 9:25. At what time did his bus leave? 9:05 8:55 8:45	Working backwards Put these times of the day in order, starting with the earliest time. A: Quarter to four in the afternoon B: 07:56 C: six minutes to nine in the evening D: 14:36	Working backwards Put these lengths of time in order starting with the longest time. 105 minutes 1 hour 51 minutes 6360 seconds	

Shape and Properties

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Visualising Put some shapes in a bag. Find me a shape that has more than three edges	Visualising In your head picture a rectangle that is twice as long as it is wide. What could its measurements be?	Visualising I am thinking of a 3dimensional shape which has faces that are triangles and squares. What could my shape be?	Visualising Imagine a square cut along the diagonal to make two triangles. Describe the triangles. Join the triangles on different sides to make new shapes. Describe them. (you could sketch them) Are any of the shapes symmetrical? Convince me	Visualising I look at a large cube which is made up of smaller cubes. If the larger cube is made up of between 50 and 200 smaller cubes what might it look like?	Visualising Jess has 24 cubes which she builds to make a cuboid. Write the dimensions of cuboids that she could make. List all the possibilities.

Angels

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
		Convince me Which capital letters have perpendicular and / or parallel lines? Convince me	Convince me Ayub says that he can draw a right angled triangle which has another angle which is obtuse.Is he right? Explain why	Convince me What is the angle between the hands of a clock at four o clock? At what other times is the angle between the hands the same? Convince me	One angle at the point where the diagonals of a rectangle meet is 36 degrees. What could the other angles be? Convince me

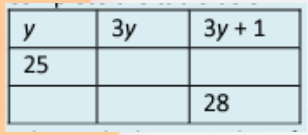
Position and Direction

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Working backwards If I face forwards and turn three quarter turns clockwise then a quarter turn anti-clockwise describe my finishing position.	If I make the two opposite sides of a square 5 cm longer the new lengths of those sides are 27cm. What was the size of my original square? What is the name and size of my new shape?	Here are the co-ordinates of corners of a rectangle which has width of 5. (7, 3) and (27, 3) What are the other two co-ordinates?	A square is translated 3 squares down and one square to the right. Three of the coordinates of the translated square are: (3,6) (8,11) (8,6) What are the co-ordinates of the original square?	Two triangles have the following co-ordinates: Triangle A: (3, 5) (7, 5) (4, 7) Triangle B: (3, 1) (7, 1) (4, 3) Describe the translation of triangle A to B and then from B to A.

Data

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	True or false? (Looking at a simple pictogram) “More people travel to work in a car than on a bicycle”. Is this true or false? Convince me. Make up you own ‘true/false’ statement about the pictogram	True or false? (Looking at a bar chart) “Twice as many people like strawberry than lime”. Is this true or false? Convince me. Make up your own ‘true/false’ statement about the bar chart.	True or false? (Looking at a graph showing how the class sunflower is growing over time) “Our sunflower grew the fastest in July”. Is this true or false? Convince me. Make up your own ‘true/false’ statement about the graph.	True or false? (Looking at a train time table) “If I want to get to Exeter by 4 o’clock this afternoon, I will need to get to Taunton station before midday”. Is this true or false? Convince me. Make up your own ‘true/false’ statement about a journey using the timetable.	True or false? (Looking at a pie chart) “More than twice the number of people say their favourite type of T.V. programme is soaps than any other” Is this true or false? Convince me. Make up your own ‘true/false’ statement about the pie chart.

Algebra

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
			Undoing If the longer length of a rectangle is 13cm and the perimeter is 36cm, what is the length of the shorter side? Explain how you got your answer.	Undoing The perimeter of a rectangular garden is between 40 and 50 metres. What could the dimensions of the garden be?	If y stands for a number complete the table below  What is the largest value of y if the greatest number in the table was 163?

y	$3y$	$3y + 1$
25		
		28