Number

Understanding prime factors

Remembering: What is a factor?
What is a prime number?

Understanding: Why is 7 prime?

Applying: What are the prime factors of 125? 81? 343? What do you notice?
Can a prime number be a multiple of 4?

Analysing: How do you go about finding the prime factors of a given number?
How do you go about finding the prime factors of a given number?

Evaluating: Can you think of a number that has one repeated prime factor?
Can you think of a number that has one repeated prime factor?
Or all different prime factors?
Which numbers less than 100 have exactly three factors?
What number up to 100 has the most factors?

Creating: The sum of four even numbers is a multiple of four. When is this statement true? When is it false?

Squares and Cubes

Remembering: What are the first 5 square/cube numbers?

Understanding: Why are 1, 4, 9, 16 called square numbers?

Applying: How would you find the 15th square number?

Analysing: Which is the square number closest to 30?

Evaluating: The sum of two square numbers is 20 – what are they?

Creating: Create a cross number based on questions about square and cube numbers.

Order of operations

Remembering: What rules do you follow?

Understanding: What does BIDMAS mean how is it used?

Applying: The answer to 5 + 2 x 3 is 21. True or False? Why?

Analysing: Why do we need bidmas?

Evaluating: What clues do you look for when you are reading a calculation and deciding the order of operations?

Creating: Create some questions where you would get the answer wrong if you didn't use BIDMAS.

Index Laws

Remembering: What happens to the powers in a question like $3^2 \times 3^5$? ....

Understanding: Can you explain to someone why 2^3 does not give the same answer as 2×3 when 2^2 is the same as 2×2?
Why do we use index notation?

Applying: Which is larger: 2^5 or 5^2?
What is the answer to $5^2 \times 5^3 = ?$

Analysing: If 5^2 can be thought of as a square of side 5 what could 5^3 represent?
Convince me that $3^7 \div 3^2 = 3^5$.

If $4^m \times 4^n = 4^{10}$ and $\frac{4^m}{4^n} = 4^4$, what are the values of *m* and *n*?

Evaluating: If $2 \times 3^n = 162$, what is the value of *n*?

Creating: The answer to a question is 2^6, what might the question have been?

Fractions

Adding and Subtracting, including mixed

Remembering: What is a denominator? What is a numerator?

Understanding: Why are equivalent fractions important when adding or subtracting fractions?
Is there only one possible common denominator?

Applying: What is a common denominator for $\frac{1}{3}+\frac{1}{4}$?

Analysing: What strategies do you use to find a common denominator when adding or subtracting fractions?
What happens if you use a different common denominator?

Evaluating: How do you show that fractions are equivalent?

Creating: The answer to a fractions question is $\frac{7}{12}$. What could be the question?

Multiplying/Dividing

Remembering: What are the first steps you need to take to divide one fraction by another?

Understanding: Explain how to cancel down a fraction, such as $\frac{4}{12}$.

Applying: Give me some examples of numbers that are easy to find one fifth of.
What about two fifths?
What about numbers that are easy to find three quarters of?

Analysing: Is there anything special about numbers that are easy to find one fifth of?

Evaluating: How would you find five eighths of a number or quantity?
If I divide one fraction by another I will always get a smaller answer – true/false? Why? Explain.
Give pupils some examples of addition, subtraction, multiplication and division of fractions with common mistakes in them. e.g. $^2/_8 + {}^3/_6 = {}^5/_{14}$ Ask them to talk you through the mistakes and how they would correct them.

Creating: The answer is: $^3/_8$What is the question?

Solving Problems

(See section on solving problems in Ratio and Proportion)

Percentages

Working out a percentage

Remembering: When calculating percentages of quantities, what percentage do you usually start from?

Understanding: How do you use the starting percentage to work out others?

Applying: Calculate 20% of £260.

Analysing: To calculate 10% of a quantity, you divide it by 10. So to find 20%, you must divide by 20. What is wrong with this statement?

Evaluating: Which is bigger 12% of 88 or 88% of 12?

Creating: What percentages can you easily work out in your head? Talk me through a couple of examples.
Give me a question with the answer 20.

Increasing or decreasing by a percentage

Remembering: What % is the initial amount before any changes take place?

Understanding: If an amount is decreased by 20%, what % will you have left?

Applying: How would you increase or decrease a price of £12 by, for example, 15%.

Analysing: An amount is decreased by 10% and the result increased by 10%. What is the resulting % increase/decrease from the original?
Explain why if we increase 300 by 25% we add the same amount as we take off if we decrease the answer by 20%.

Evaluating: Are there any other ways that you can increase or decrease an amount by a given %?
How would you find the multiplier for different percentage increases/decreases?

Creating: The answer to a percentage increase question is £10. Make up an easy question. Make up a difficult question.

Decimals and Estimation

Fractions to decimals conversion

Remembering: What sets of equivalent percentages, fractions and decimals do you know?

Understanding: What denominators make it easy to change a fraction to a decimal?

Applying: How would you find out which of these is closest to 0.3: $^{10}/_{31}$; $^{20}/_{61}$; $^{30}/_{91}$; $^{50}/_{151}$?

Analysing: Explain how you can use equivalent sets of %, decimals and fractions that you know, to find other equivalent sets.
How would you go about finding the decimal equivalents of any fraction?

Evaluating: Give me a fraction between ⅓ and½. How did you do it? Is it closer to ⅓or½? How do you know?

Creating: Create three conversion questions at different levels of difficulty.

Decimal arithmetic

Remembering:	If units are just before the decimal point, what is just after?
Understanding:	What is a 'decimal'?
	What is the purpose of the decimal point?
Applying:	What do you have to add to 0.03 to make 0.7?
Analysing:	Explain why 0.3 x 0.07 is the same as 0.03 x 0.7
Evaluating:	Why is 0 so useful when it is worth nothing?
	How would you explain to someone that 0.35 is greater than 0.035?
	Multiplying makes numbers bigger. When is this statement true and when is it false?
	Division makes numbers smaller. When is this statement true and when is it false?
	How would you justify that dividing by ½ is the same as multiplying by 2?
Creating:	The answer to a question is 0.35. What might the question have been?

Rounding and Significant Figures

Remembering:	Which is the first significant figure in the number 0.00315
Understanding:	How do you go about rounding a number to the nearest 100? What do you look for?
	Is 230 rounded to the nearest 10, 100 or 1000? How do you know?
	How do we know if figures are significant?
	How do we know which figures are significant?
Applying:	Rounded to three sf (dp) which is the odd one out: 0.5528, 0.5523 and 0.5531
Analysing:	Is 500 rounded to the nearest 10, 100 or 1000? How do you know?
	What is the largest/smallest number to one decimal place that would be rounded to 7?
	What is the largest/smallest number to two decimal places that would be rounded to 7?
	What is the largest/smallest number altogether that would be rounded to 7?
Evaluating:	Why do we need significant figures for rounding?
	Why do we use significant figures for rounding?
Creating:	Find a number that rounds to the same amount whether you round it to 3sf or 2dp.

Estimating by Rounding

Remembering:	What are the different types of rounding?
	How many significant figures do we round to when we are estimating an answer?
Understanding:	Why do we round to make estimates?
Applying:	Talk me through how you would use rounding to estimate the answer to this calculation.
Analysing:	Explain what is wrong with this estimate: 1.6 x 0.9 = 2
Evaluating:	What influenced your decision about how to round?

Creating: The answer to a rounding question is 20. What could the original, unrounded numbers have been?

Manipulating Decimals

Remembering: If units are just before the decimal point, what are the two numbers after it?

Understanding: How would you explain to someone how to multiply a decimal by 10 … , how to divide a decimal by 100? …

Applying: This calculator display shows 0.001. Tell me what will happen when I multiply by 100. What will the display show?

Analysing: I divide a number by 10, and then divide the result by 10. The answer is 0.3. What number did I start with? How do you know?

Evaluating: Why do 2.5 ÷ 10 and 25 ÷ 100 give the same answer?

Creating: Create three decimal questions which all give the same answer.

<u>Indices, Standard Form and Surds</u>

Using standard form

Surds

Ratio

Simple ratio

Remembering: What's the symbol we use in ratio?

Understanding: Explain what 3:2 means

Applying: Simplify the ratio 16:28

Analysing: Which is the larger ratio, 8:3 or 13:5

Evaluating: Describe to a partner how you would go about simplifying a ratio.

Creating: There are 20 boys and 10 girls in Class 7G. Make up some sentences using the words 'ratio' or 'proportion'.

Look at this two-way table.

	BOYS	GIRLS
Glasses	1	3
No Glasses	2	4

Give me a question that has the answer: 3 : 7, 40%, 2 : 1, $\frac{2}{3}$.

Show pupils two red and three green interlocking cubes and ask them to make as many different statements as they can.

Sharing a quantity in a given ratio/ ratio problems

Remembering: If you had to split an amount in the ratio 2:3 what would you have to do to the numbers 2 and 3?

Understanding: Explain how you know what to divide an amount by for a given ratio question

Applying: Divide £120 in the ratio 1:2

Analysing: What amounts would be easy to split in the ratio 2:3?

Evaluating: If the ratio of boys to girls in a class is 3 : 1, could there be exactly 30 children in the class? Why? Could there be 25 boys? Why?

Would you prefer to have the largest part of £200 split in the ratio 5:3 or the smaller part of £294 in the ratio 4:3

Creating: 5 miles is about the same as 8 km. Can you make up some conversion questions that you could answer mentally?

Expressions and Sequences

Like Terms

Remembering: What are like terms?

Understanding: Which of the following are like terms...

Match up the following into pairs of like terms...

Applying: What do you look for when you have an expression to simplify? What are the important stages?

Analysing: 2x-x=2. Why is this not always true?

Why can we not say that 3a+5b=8ab?

Evaluating: Can this be simplified: aba + baa – a^2b – explain your answer.

Creating: Can you write an expression that would simplify to, e.g: $6m - 3n$? Are there others?

Substitution

Remembering: What does substituting a number mean?

Understanding: What would you need to be told if you were asked to find the value of $2x^2$?

Applying: If x = -2 and y = 3 which of the following equals 0: 2x + y, 3x + 2y or y = x

Analysing: If x = 3 and y = 4 which of these is bigger and by how much: $3x^2$ or $y^2 + 4x$

Evaluating: $p = 4a^2$ and $p = (4a)^2$ Do these two formulae give the same answer or different ones? When? Why?

Creating: When you substitute $x = -1$ into the formula $y = 5x - 2$ you get -7. Can you make up some more formulae that also give $y = -7$ when $x = -1$ is substituted?
When you substitute $a = 2$ and $b = 7$ into $t = ab + 2a$ you get 18. Can you make up some more formulae that also give $t = 18$ when $a = 2$ and $b = 7$ are substituted?

Index Laws

Remembering: What is another word for an index?

Understanding: Can you explain to someone why 2^3 does not give the same answer as 2×3 when 2^2 is the same as 2×2?
Why do we use index notation?

Applying: What is the answer to $a^2 \times a^3 = ?$

Analysing: Convince me that $g^7 \div g^2 = g^5$.

Evaluating: If x^2 can be thought of as a square of side x what could x^3 represent?

Creating: Give three different index questions that all give the sane answer.

Fractional, zero and Negative Powers

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Term to Term and Position to Term Definitions

Remembering: What is a sequence?

Understanding: What do you notice when I subtract 10 from a number? Can you explain?

Applying: How would you go about finding the term-to-term rule for this information on a sequence:

Position	3	5	10
Term	11	19	39

Analysing: If you were to start with 93 and count back in tens, what would be the smallest number you would reach on a 1–100 grid? Would 14 be one of the numbers you would say? Why not?

Evaluating: If you count in tens from 42, which digit changes? Why doesn't the ones digit change?
I know a secret sequence. It has these numbers in it: 13, 15, 17, 19. What numbers come next in my sequence? What numbers come

before? What clues did you use to work this out? Give me a number that is greater than 50 that is in my secret sequence. Tell me how you know this number is in my sequence. How could you check? Is 64 in the sequence? How do you know?
Use similar questions for a range of sequences.
Find and explain the rules if the next number in the sequence 2, 3, 5, 8... is a) 12, b)13.

Creating: How could this sequence continue: 1, 2... What would be the rule in each case?

The n^{th} Term of an Arithmetic Sequence

Remembering: What is an arithmetic sequence?

Understanding: What do we mean by an nth term?

Applying: How would you go about finding the position-to-term (n^{th} term) rule for this information on a sequence:

Position	3	5	10
Term	11	19	39

Analysing: What do you look for in your sequence to help you find the *n*th term?

Evaluating: The term-to-term rule for a sequence is 'previous term + 2'. What does that tell you about the position-to-term rule? Do you have enough information to find the rule for the *n*th term? Why?
How do you formulate the nth term for a given sequence.

Creating: Create three different sequences where the 5^{th} term is 13.

<u>Expanding Brackets and Factorising</u>

Expanding Brackets/Factorising by common factors

Remembering: What is a factor?

Understanding: What do you look for when you have an expression to factorise? What are the important stages?
What hints and tips would you give to someone about expanding a bracket

Applying: Which of the following is the expanded format of 3(2x – 3): 6x – 3, 5x – 6 or 6x – 9?

Analysing: List as many factors as possible of the term $12x^3$

Evaluating: How can you check that your factorising is correct?

Creating: Can you write an expression that would simplify to, e.g: 8 (3*x* + 6)? Are there others?

Expanding product of two brackets/Factorising quadratic expressions

Remembering: What terms does an expression have to have to be able to factorise it into two brackets?

Understanding: When expanding brackets such as (x + 3)(x – 5) how many multiplications do you have to make?

Applying: How do you go about expanding this pair of brackets?

Analysing: What do you have to look out for?

Evaluating: What makes these difficult?

Creating: Give me some examples that you typically find easy.
Give me some examples that you typically find difficult.

Graphs

Drawing Straight line graphs

Remembering: How many points do you need to draw a straight line graph?

Understanding: Why is the point (3, 6) not on the line $y = x + 2$?

Applying: If I wanted to plot the graph $y = 2x$ how should I start?
How do you go about finding a set of coordinates for a straight-line graph, for example $y = 2x + 4$?

Analysing: A student has completed the following table for a straight line graph. Explain which point is incorrect:

x	1	2	3	4
y	10	8	5	4

Evaluating: How do you decide on the range of numbers to put on the *x* and *y* axes?
How do you decide on the scale you are going to use?

Creating: Can you give me the equations of some graphs that pass through (0, 1)?
What about …

Midpoint of a line segment

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Gradient and y intercept (y=mx+c)

Remembering: What is the general equation of a straight line graph?

Understanding: How do you go about finding the gradient for a straight-line graph...
that has been drawn on a set of axes?
from the equation given in the form $y = mx + c$?
from a table of coordinates?
What happens to the straight-line graph as *m* is changed (increases, decreases, is negative)? What happens as *c* is changed?

Applying: For the line y = 3 – 2x, what is the gradient and what is the y-intercept?

Analysing: If you increase/decrease the value of *m*, what effect does this have on the graph? What about changes to *c*?
How would you go about identifying the graph of $y = 3x – 5$ on a set of axes?

Evaluating: What have you noticed about the graphs of functions of the form $y = mx + c$? What are the similarities and differences?

Creating: Find the equations of three lines which pass through the point (7, 2)

Parallel and perpendicular

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Real life graphs/Compound measures

Remembering:

Understanding: What do the axes represent?

Applying:

Analysing: In the context of this problem, does every point on the line have a meaning? Why?
What does this point on the graph represent?
What does this part of the graph represent?
Given that a person averaged 40 mph on a car journey that took 3 hours, is it correct to say that after one and a half hours they had travelled 60 miles? Why?

Evaluating:

Creating: What sort of questions could you use your graph to answer?
Give me some examples of statements that are definitely true.
Give me some statements that could be true.

Formulae

Remembering:

Understanding: What is the difference between an equation, formula, identity and expression? Give some examples
How do you know whether a letter symbol represents an unknown number or variable quantity and not a label?

Applying:

Analysing:

Evaluating: In what circumstances would you use each of an equation, formula, identity and expression??

Creating:

Distinguishing between the terms formulae, equation, identity and expression

Using formulae

Writing formulae

Algebraic Fractions and Algebraic Proof

Simplify algebraic fractions

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Adding and subtracting algebraic fractions

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Multiplying and dividing algebraic fractions

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Algebraic proof

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Basic Shape and Measure

Symmetry in 2D shapes

Remembering:

Understanding: What do you look for when trying to decide whether a shape has at least one line of symmetry?
How do you go about finding lines of symmetry in a shape?
What clues do you look for when deciding whether a shape has been formed by reflection or rotation?

Applying:

Analysing: Talk me through what you notice in these shapes.
What is the order of rotational symmetry of each of the quadrilaterals you sketched?
What is the order of rotational symmetry for each of these quadrilaterals?

Evaluating:

Creating: Make up a reflection or a rotation that is easy to do.
Make up a reflection or a rotation that is hard to do.
What makes it hard?
Sketch me a quadrilateral that has one line of symmetry; or two lines; three lines; no lines, etc. Can you give me any others?
Sketch a quadrilateral that has just one line of symmetry; or two lines, three lines, four lines, no lines.

Converting units of measure

Remembering: What rough metric equivalents of imperial measurements do you know?

Understanding: What clues do you look for when deciding which metric unit is bigger?
Explain how you convert metres to centimetres. How do you change grams into kilograms, millilitres into litres, kilometres into metres, etc.?
How would you change metres into feet, kilometres into miles, etc.?
When reading scales how do you decide what each division on the scale represents?

Applying: Estimate the answer to your problem.
Which is better value for money, £4 for a gallon of petrol or 80p for a litre?
Explain what information you need to explore this problem? Could you do it in a different way? How?

Analysing: Which is bigger, 200 cm or 20 000 mm? Explain how you worked it out.

Evaluating:

Creating: Can you make up a practical problem that requires use of square metres?

<u>Angles,Polygons and circles</u>

Angle properties of parallel lines

Remembering:

Understanding: How do you go about identifying parallel lines
Give me some examples of shapes that have pairs of parallel lines.

Applying:

Analysing: What do you understand by perpendicular lines? Can a triangle have sides that are a pair of perpendicular lines? Why?

Evaluating:

Creating:

Proving and using angle properties of triangles and quadrilaterals

Remembering:

Understanding: Why are parallel lines important when proving the sum of the angles of a triangle?
Can you explain why the exterior angle of a triangle is equal to the sum of the two interior opposite angles?
How does knowing the sum of the angles of a triangle help you to find the sum of angles of a quadrilateral? Will this work for all quadrilaterals? Why?
What is the same about a square and a rectangle? What might be different?
Which quadrilateral with one line of symmetry has three acute angles?

Applying:

Analysing: Give me some instructions to help me to draw a rectangle.
Is it possible for a quadrilateral to have only three right angles? Why?

Evaluating: How could you convince me that the sum of the angles of a triangle is 180°?
Why can't a trapezium have three acute angles?

Creating: Is it possible to draw a triangle with:
One acute angle?
Two acute angles?
One obtuse angle?
Two obtuse angles?
Why?
Give an example of each triangle, suggesting the sizes of the three angles, if it is possible. If it is impossible, explain why.

Angles of elevation and depression

Remembering:

Understanding:

Applying:

Analysing:

Evaluating:

Creating:

Polygons

Remembering: Show me a regular polygon. How do you know it is regular? What do you look for?

Understanding: Is this polygon regular? (Show a shape with equal sides but not equal angles.) Why not?
How can you use the angle sum of a triangle to calculate the sum of the interior angles of any polygon?
If the polygon is regular, what else can you calculate?

Applying: Show me a polygon that is regular and has at least one right angle. Are there any others?

Analysing:

Evaluating: How would you convince somebody that the exterior angles of a polygon add up to 360°?

Creating:

Isosceles triangles in circles

Remembering:
Understanding:
Applying:
Analysing:
Evaluating:
Creating:

Tangents to a circle

Remembering:
Understanding:
Applying:
Analysing:
Evaluating:
Creating:

Areas and Volume

Areas of Triangles, parallelograms and trapeziums

Remembering: What other formulae for the area of two-dimensional shapes do you know?

Understanding: Why do you have to multiply the base by the perpendicular height to find the area of a parallelogram?

Applying: Right-angled triangles have half the area of the surrounding rectangle with the same base and height. What about non-right angled triangles?

Analysing:

Evaluating: Is there a formula for every two-dimensional shape?

Creating: The area of a triangle is 12 cm^2. What are some possible lengths of the base and height?

Problems involving perimeter and area

Remembering:

Understanding: Why is it a good idea to split this shape into rectangles to find the area?

Applying: How do you go about calculating the dimensions of the rectangles in the compound shape?

Analysing:

Evaluating:

Creating: Form a compound shape by pushing together two rectangles. Compare the areas and perimeters of the rectangles with those of the compound shape. What has changed and why? What happens if you join the rectangles in a different way? Why?

Drawing 3D shapes/Elevations and plans

Remembering:

Understanding: How would you go about drawing the plan and elevation for the 3-D shape you could make from this net?

Applying:

Analysing: Starting from a 2-D net of a 3-D shape, how many faces will the 3-D shape have? How do you know?
What will be opposite this face in the 3-D shape? How do you know?
Which side will this side join to make an edge? How do you know?

Evaluating: Given this plan and elevation, what can you know for sure about the 3-D object they represent? What can you not be sure about?

Creating:

Volume of a cuboid/Prism & Surface area of a cuboid/Prism

Remembering: What makes a three-dimensional shape a prism?

Understanding: What can you say about the shapes that make up the surface area of a prism?
How do you go about finding the surface area of a prism?
How do you go about finding the volume of a cuboid?
How do you go about finding the surface area of a cuboid?

Applying:	What are the important steps in calculating the volume of a prism? Show any net of a cube or a cuboid. Where would you put the tabs to glue the net together?
Analysing:	
Evaluating:	'You can build a solid cuboid using any number of interlocking cubes.' Is this statement always, sometimes or never true? If it is sometimes true, when is it true and when is it false?
Creating:	For what numbers can you only make one cuboid? For what numbers can you make several different cuboids?

3D coordinates

Remembering:
Understanding:
Applying:
Analysing:
Evaluating:
Creating: