JAMES COOK
LEARNING TRUST

YEAR 6

MATHS CURRICULUM

KNOW IT

YEAR 6

New Learning | Prior Learning

PLACE VALUE

- Know the value of each digit in an 8-digit number
- Know the value of each digit in an 7-digit number
- Count **forwards** in powers of 10 for any given number up to 1, 000,000
- Count **backwards** in powers of 10 for any given number up to 10, 000,000
- Count **backwards** in powers of 10 for any given number up to 1, 000,000

GEOMETRY

- Know the parts of a circle
- Know the diameter is twice the radius in length.
- Know that vertically opposite angles are equal.
- One whole turn = 360 °
  ½ a turn and angles on a straight line = 180 °

STATISTICS

- Know the method for calculating mean average.

MEASURES

- Know that 5 miles is approximately 8km
- 1000m =1km; 100cm =1m; 10mm=1cm
- 1000g = 1 kg
- 1000ml = 1l
- 1 inch = 2.5 cm; 1 foot = 12 inches
- 1 kg = 2.2lb
- 1 litre = 1.75 pints
- Area of a triangle = ½ b x h
- Area of a parallelogram = b x h
- Area of a rectangle = l x w
  Perimeter of a rectangle = (2 x l) + (2 x w)
- Volume = l x h x d

CALCULATIONS

- Know and apply the rules of BODMAS

F, D & P

- Know the value of each digit in a number with 3 decimal places.
- $0.1 = {}^{1}/_{10} = 10\%$
- $0.01 = {}^{1}/_{100} = 1\%$
- $0.5 = {}^{50}/_{100} = 50\%$
  $0.25 = {}^{25}/_{100} = 25\%$
- $0.2 = {}^{1}/_{5} = 20\%$
  $0.4 = {}^{2}/_{5} = 40\%$ etc
- Know that x means of

RATIO & PROPORTION

- Know and use the ratio symbol :

New Learning | Prior Learning

TEACH IT: NUMBER & PLACE VALUE

YEAR 6

KEY OBJECTIVES

- Read, write, order and compare numbers up to 10,000, 000 and determine the value of each digit.
- Read, write, order and compare numbers to at least 1,000,000 and determine the value of each digit.
- Count forwards or backwards in steps of power of 10 for any given number up to 1,000,000.
- Round any whole number to a required degree of accuracy.
- Round any number up to 1,000,000 to the nearest 10, 100, 1000, 10,000 and 100,000.
- Use negative numbers in context, and calculate intervals across zero.
- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero.

POSSIBLE STEPS TO SUCCESS

Read, write, order and compare...

⇒ Know place value of 8 digit numbers.
⇒ Represent with various manipulatives and visuals e.g. place value counters, gattegno chart
⇒ Read and write numbers beyond a million.
⇒ Partition 8 digit numbers (thousands, hundreds, tens and ones).
⇒ Partition in different combinations e.g. 50, 004, 500 = 50 millions and 45 hundreds.
⇒ Order a set of numbers from largest to smallest; smallest to largest on a variety of scales and number lines.
⇒ Use and = signs

Round any numbers in context…

⇒ Identify the digit within the number to round to using place value knowledge.
⇒ Recognise position of digit relative to multiples of 10/100/1000 etc either side & place on number line.
⇒ Determine which multiple the number is closest to & round to given multiple.
⇒ Spot patterns and apply when rounding e.g. 4 or below, round down.

Use negative numbers in context...

⇒ Understand zero and the concept of negative numbers.
⇒ Count backwards in different steps.
⇒ Use negative symbol and terminology e.g. negative 4 not minus 4.
⇒ Place both negative and positive numbers on a number line, seeing pattern of negative numbers.
⇒ Recognise distance between a positive and negative number, using knowledge to calculate an interval.

STEM SENTENCES

- 'There are ten millions in ten million.'
- 'There are ten one thousand thousands in a million.'
- '23, 456, 132 is 23, 456, 132 ones. 23, 456, 132 is 23 millions and 456, 132 ones (etc)'
- 'When rounding to the nearest___, the _____digit is the digit to consider. If the digit is 4 or less, round down. If it is 5 or more than round up.'
- 'When we count back from 0, the digit gets larger but the value gets smaller.'

KEY TERMINOLOGY

- **Represent**
- **Representation**
- **Value**
- **Sequence**
- **Identify**
- **Estimate/ Approximate**
- **Roman Numerals**
- **Digit**
- **Partition**
- **Inequality symbol**
- **Ascending**
- **Descending**
- **Negative number**
- **Compare**
- **Partition**

COMMON MISCONCEPTIONS

- Not knowing to use 0 as a place holder when a column is empty.
- Not knowing the value of a digit e.g. '3 in 3421 is worth 3.' instead of ' 3 in 3421 is worth 3000.'
- Not recognising that numbers can be partitioned in more ways than just its place value heading.
- Comparing numbers by the first digit, not the number of digits.
- Misunderstanding value of negative numbers e.g. –5 is more than –1 or writing a sequence as 23, 13, 3, -3, -13.
- Looking at the wrong column when rounding e.g. looking at the hundreds column when rounding to the nearest 100.
- Missing out 0 when counting forwards/backwards.

KEY VOCABULARY

⇒ **Round**-giving a number a nearby value when you don't need it to be exact.
⇒ **Negative number –** any number less than zero written with a negative sign.
⇒ **Positive number**– any number greater than zero.
⇒ **Multiple–** product of one number multiplied by another number.
⇒ **Numeral**-figure or symbol or a group of figures that denote a number.

New Learning | Prior Learning

TEACH IT: CALCULATIONS

YEAR 6

KEY OBJECTIVES

- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for 2 digit numbers.
- Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- Divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context.
- Divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.
- Perform mental calculations, inc with mixed operations & large numbers.
- Add and subtract numbers mentally with increasingly large numbers, multiply and divide numbers mentally drawing upon known facts.
- Identify common factors, common multiples and prime numbers.
- Identify multiples & factors, including finding all factor pairs of a number, and common factors of two numbers.
- Know and use the vocabulary of prime numbers, prime factors & composite (non-prime) numbers.
- Establish whether a number up to 100 is prime & recall prime numbers up to 19.
- Use their knowledge of the order of operations to carry out calculations involving the four operations .
- Recognise and use square numbers and cube numbers, and the notation for squared (2) and cubed (3).
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

POSSIBLE TEACHING SEQUENCE

Multiply multi-digit numbers...

⇒ Teachers should refer to calculations policy for how to explicitly teach the steps required in long multiplication.

Divide numbers up to 4 digits...long division & short division.

⇒ Distinguish between grouping and sharing using practical apparatus.

⇒ Teachers should refer to calculations policy for how to explicitly teach the steps required in long division.

⇒ Look at different written problems, determining the required answer; discuss the remainder that is needed.

⇒ Apply this logic to a range of calculations inc both written & arithmetical.

Perform mental calculations…

⇒ Count forwards and backwards in steps of any given value, recognising the place value of digits within a number and how they change.

⇒ Round and adjust (possibly jotting a number line) to add and subtract.

⇒ Apply knowledge of place value and partitioning to add or subtract numbers with multiple digits.

⇒ Apply knowledge of number bonds to cross boundaries of multiples of 10 when adding numbers.

⇒ Use knowledge of doubling/halving to double/half known table facts in mental multiplication/division e.g. I know 12 x 4 = 48 therefore 24 x 4 = 96.

⇒ Use knowledge of multiplying/dividing by 10/100/1000 to perform mental calculations with decimals e.g. I know 3 x 5 = 15, therefore 0.3 x 5 = 1.5.

Identify common factors…

⇒ Find factors for two different numbers and identify similar factors, recognising this as common.

⇒ Find multiples for two different numbers and identify similar multiples, recognising this as common.

⇒ Learn off by heart prime numbers up to 20.

⇒ Identify times table patterns that could quickly determine the likelihood of a number being prime.

⇒ Break a number down to its prime factors through a prime factor tree.

Use their knowledge of the order of operations...

⇒ Understand what is meant by order of operations.

⇒ Know and understand squared, cubed and brackets.

⇒ Learn in order the abbreviation BODMAS & understand how not following this systematic order could provide different answers.

STEM SENTENCES

- 'If one factor is made ten times the size, the product will be ten times the size e.g. 12 x 17 = 204 so 12 x 170= .'
- 'If factors are ten times smaller, the product will be ten times smaller e.g. 12 x 8 = 96 so 1.2 x 8 or 12 x 0.8 =.'
- 'Factors are the whole numbers that multiply to make a number.'
- 'I know that 389 is close to 400 so in 389 + 25, I can do 400 + 25, then subtract 11.'
- 'For calculations that involve both + and - steps, we can + then-or-then +; the final answer is the same.'
- ' In column addition, we start at the right hand side.'
- 'If the column sum is equal to 10 or more then we must regroup.'
- 'Subtraction cannot be done in any order.'
- ' When using column subtraction, if the digit on the top is lower than that of the digit on the bottom then exchange.'

KEY TERMINOLOGY

- **Mental**
- **Efficient**
- **Calculation**
- **Partition**
- **Addition/Add**
- **Sum**
- **Total**
- **Plus**
- **Altogether**
- **Subtract**
- **Difference**
- **Fewer**
- **Less**
- **Takeaway**
- **Minus**
- **More**
- **Combined**
- **Column/Row**
- **Exchange**
- **Regroup**
- **Multiplication/Multiply**
- **Division/Divide**
- **Recall**
- **Double/Half**
- **Derive**
- **Multiple**
- **Groups of**
- **Times**
- **Repeat**
- **Left /Remainder**
- **Scale**
- **Bar model**
- **Systematic**
- **Inverse**

COMMON MISCONCEPTIONS

See also misconceptions from previous years as many are still relevant in Y6.

Thinking that formal written methods are the only way to + or - rather than choosing the most efficient methods e.g. using a column method for 9000-8999.

Not multiplying all given digits in a number by all given digits in the multiplier e.g. 23 x 45 becomes 2 x 4 & 3 x 5.

Mixing up factors and multiples.

Assuming 1 is a prime number as it is only divisible by 1 instead of recognising that a prime number has 2 factors.

Thinking that ^{2} means x 2 instead of multiplying by itself.

KEY VOCABULARY

⇒ **Prime number**: a number divisible by only 2 factors: one and itself.

⇒ **Factor**: a whole number that divides exactly into another number.

⇒ **Product**: the result when two numbers are multiplied together.

⇒ **Order of Operations:** the order in which mathematical calculations must be done.

⇒ **Equation:** mathematical statement containing an = sign to show 2 expressions are equal.

⇒ **Expression**: one or a group of terms & may include at least 2 numbers & at least 1 operation.

New Learning | Prior Learning

TEACH IT: FRACTIONS

YEAR 6

KEY OBJECTIVES

- Use common factors to simplify fractions; use common multiples to express fractions in the same denomination.
- Identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths.
- Compare and order fractions, including fractions > 1
- Compare and order fractions whose denominators are all multiples of the same number.
- Recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1
- Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions.
- Add and subtract fractions with the same denominator and denominators that are multiples of the same number.
- Multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, ¼ x ½ = ⅛
- Multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams.
- Divide proper fractions by whole numbers.

POSSIBLE TEACHING SEQUENCE

Use common factors...

⇒ Identify common factors of the numerator and denominator of a given fraction.

⇒ Divide both the numerator and denominator, recognising when the fraction cannot be divided any further and reasoning why.

⇒ Understand this as the simplest form.

⇒ Identify common factors and multiples of given denominators and numerators of multiple fractions.

⇒ Convert the fractions so that the denominators are the same, remembering to perform the same calculation to the numerator also.

Compare and order fractions...

⇒ Recognise when a mixed number has more parts and is therefore greater, without needing to convert the fractions.

⇒ Recognise when the parts in a fraction are greater than the parts in another given fraction, therefore meaning the fraction is larger (e.g. 7/8 is greater than 1/7), meaning that the fractions do not need to be converted.

⇒ Use knowledge of common factors and multiples to convert fractions so they have the same denominators.

⇒ Compare using < > and =

Add and subtract fractions...

⇒ Add and subtract fractions with the same denominator recognising that the numerator shows the number of parts you have and therefore only this part of the fraction is added/subtracted.

⇒ Use knowledge of common factors & multiples to convert fractions so they have the same denominators to add non-unit fractions with different denominators.

⇒ Progress to adding mixed numbers, adding the wholes and then the parts, converting denominators if necessary.

⇒ Subtract mixed numbers, subtracting the wholes then the parts and converting if necessary.

⇒ Add and subtract mixed numbers where exchanging and regrouping is necessary.

⇒ Always convert the answer to the simplest form.

Multiply simple pairs...

⇒ Recognise what the multiplication statement says. E.g. ½ x ¼ means half of a quarter.

⇒ Show this with bar models to understand why ½ x ¼ = 1/8

⇒ Progress to multiplying fractions without the bar model.

⇒ Multiply mixed numbers by fractions e.g. 1 ½ x ¼

Divide proper fractions

⇒ Recognise what the division statement means e.g. 2 ÷ ½ means ½ of 2 and therefore means ½ x 2 as x means of.

⇒ Show the above calculation with bar models to aid understanding.

⇒ Recognise that the whole number can also be written as 2/1 so that the calculation resembles multiplying two fractions.

⇒ Carry out the multiplication in a similar manner to multiplying two fractions.

STEM SENTENCES

- 'To simplify a fraction, find the highest common factor of the numerator and denominator.'
- 'When adding/subtracting mixed numbers, add/subtract the whole, check the denominators, add/subtract the numerator.'
- 'When adding/subtracting fractions, check that the denominators are the same, then add/subtract the numerator.'
- 'To multiply fractions, multiply the numerators and multiply the denominators.'
- 'To find an equivalent fraction, whenever you multiply/divide the numerator, you must multiply/divide the denominator.'
- 'If the denominators are the same, the greater the numerator, the greater the fraction.'
- 'If numerators are the same, the greater the denominator, the smaller the fraction.'

KEY TERMINOLOGY

- **Fraction**
- **Tenths**
- **Hundredths**
- **Thousandths**
- **Equal**
- **Part**
- **Equivalent**
- **Whole**
- **Factors**
- **Multiples**
- **Numerator**
- **Denominator**
- **Decimal point**
- **Common factor**
- **Unit fraction**

COMMON MISCONCEPTIONS

- Adding/subtracting the denominator when adding/subtracting fractions-linked to knowledge of numerator/denominator.
- Adding/subtracting to find equivalent fractions instead of multiplying/dividing.
- Simplifying a fraction by dividing the numerator and denominator by 2 until you can't anymore.
- Always thinking that wholes must always be exchanged or regrouped in any calculation.

KEY VOCABULARY

⇒ **Mixed number** – a number made up of a whole number and a fraction.

⇒ **Proper fraction** – a fraction where the numerator is less than the denominator.

⇒ **Improper fraction** – a fraction where the numerator is more than the denominator.

New Learning | Prior Learning

TEACH IT: DECIMALS & PERCENTAGES YEAR 6

Key Objectives

- Associate a fraction with division and calculate decimal fraction equivalents e.g. 0.375, for a simple fraction e.g. ⅜.

- Read and write decimals numbers as fractions.
- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents.

- Identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places.

- Read, write, order & compare numbers with up to 3 decimal places.

- Multiply 1-digit numbers with up to 2 decimal places by whole numbers.
- Use written division methods in cases where the answer has up to 2 decimal places.
- Solve problems which require answers to be rounded to specific degrees of accuracy.

- Round decimals with 2 decimals places to the nearest whole number and to 1 decimal place.

- Recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.
- Solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison.

- Recognise the per cent symbol (%) and understand that per cent relates to 'number of parts per hundred', and write percentages as a fraction with denominator 100, and as a decimal.
- Know percentage and decimal equivalents of ½, ¼, $^1/_5$, $^2/_5$, $^4/_5$ and those fractions with a denominator of a multiple of 10 and 25.

Possible Teaching Sequence

Associate a fraction...
⇒ Recognise that ¼ is the same as 1 ÷ 4 etc.
⇒ Place the numerator inside the bus stop and denominator outside.
⇒ Place a decimal point followed by zeros after the numerator to allow for any remainders to be exchanged e.g. one unit is exchanged for ten tenths.
⇒ Ensure there is a decimal point pre-placed above the bus stop to allow for answer to be written correctly.

Identify the value of…
⇒ Recognise what tenths, hundredths and thousandths actually mean.
⇒ Identify how many decimal places are in any given number.
⇒ Understand that multiplying by 10, 100 and 1000 means making any given digit this many times bigger and subsequent effect on the place value of the digit..
⇒ Understand that dividing by 10, 100 and 1000 means sharing a digit into this many pieces and subsequent effect on the place value of the digit.

Multiply 1-digit numbers with…
⇒ Place the decimal number above the multiplier and ensure that the answer box has decimal points pre-placed.
⇒ Follow written calculation method for multiplying numbers together, ensuring the digits are placed correctly in relation to the decimal being multiplied.
⇒ Progress to knowledge of tables to assist with x decimals, recognising where an answer can't be correct, or with removing & replacing the decimal point.

Use written methods...Solve problems…
⇒ Place the decimal within the bus stop and ensure there is a decimal pre-placed above the bus stop where the answer will be.
⇒ Recognise that zeros can be used as place holders when there is a remainder that needs to be regrouped (see guidance in previous step).
⇒ Progress to knowledge of tables to assist with ÷ decimals, recognising where an answer can't be correct, or with removing & replacing the decimal point.
⇒ Round the answer to suit the context of the problem.

Recall and use equivalences...
⇒ Identify why decimals can easily be converted to equivalents including 10, 100 or 1000 as the denominator.
⇒ Relate knowledge of /10, /100 and /1000 to decimal place value and convert fractions to decimals (and vice versa).
⇒ Use knowledge described above to change fractions that do not have an equivalent denominator of /10, /100 and /1000 to a decimal.
⇒ Understand that % means out of 100 and link to knowledge of hundredths within decimals and /100 within fractions to change decimals to % and vice versa.
⇒ Recognise that a % can include a decimal value Apply knowledge to numbers > 1 e.g. 1 ½ = 1.5 = 150%

Solve problems involving the calculation of percentages...
⇒ Understand what percentage means & identify that a total sample is 100%
⇒ Recognise that 100% = one hundred lots of 1% or ten lots of 10%.
⇒ Establish how to find 1% and 10% by dividing by 10 and 100.
⇒ Represent finding a percentage of an amount in a bar model.
⇒ On finding 1% and 10%, scale these up or down to find other amounts.
⇒ Link knowledge of percentages to fractions, and when finding a percentage of amount, find a fraction of an amount. Use bar models to support.

Stem Sentences

- 'I know percent means out of 100 so 25% is 25/100.'
- '50% x _____ means 50% of _____.'
- 'To express a fraction as a decimal, divide the numerator by the denominator.'
- '____ decimal places means there are _____ digits after the decimal point.'

Key Terminology

- **Fraction**
- **Tenths**
- **Hundredths**
- **Thousandths**
- **Equal**
- **Part**
- **Equivalent**
- **Whole**
- **Factors**
- **Multiples**
- **Numerator**
- **Denominator**
- **Decimal point**

Common Misconceptions

- A number with more decimal places is greater e.g. 0.03 is greater than 0.3.
- When converting fractions to decimals, not using their knowledge that a numerator can be divided by the denominator. Therefore although they recognise simple fraction/decimal conversions, they struggle converting fractions such as $^{23}/_{100}$.
- When finding 10% of a number, multiplying by 10 instead of dividing by 10.
- Reading a decimal as zero point twenty four instead of zero point two four
- Not recognising that x means of to assist with calculating percentages of quantities or when dividing a fraction by a whole.
- Thinking that $^1/_{10}$ = 10% so $^1/_{20}$ = 20%
- 0.84 = $^{84}/_{10}$

Key Vocabulary

⇒ **Percent/Percentage** - a part out of a hundred.

⇒ **Decimal place** –a digits place after the decimal point.

New Learning | Prior Learning

TEACH IT: RATIO & PROPORTION

YEAR 6

KEY OBJECTIVES

- Solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts.
- Solve problems involving similar shapes where the scale factor is known or can be found.
- Solve problems involving unequal sharing and grouping using knowledge of fractions and multiples.

POSSIBLE TEACHING SEQUENCE

Solve problems involving the relative sizes…

⇒ Understand what is meant by the terminology ratio & proportion.
⇒ Compare and record two groups using correct ratio notation.
⇒ Record a group as a proportion of the whole, recognising that this is also a fraction.
⇒ Know that whenever we change one side or a ratio, we must change the other side.
⇒ Increase/decrease two parts by their relative quantities to scale a ratio up or down.

⇒ Know that ratio

Stars	1	2	3	4	5	6	7	8	9
Suns	3	6	9	12	15	18	21	24	27

l that these are equivalent ratios, linking

Solve problems in

⇒ Understand what is meant by scale and scale factor.
⇒ Enlarge or reduce a shape/measurement from a given scale factor.
⇒ Calculate scale factors by comparing shapes with given measurements, including scale factors that may be decimals e.g.1.5.
⇒ Calculate missing sides from given scale factors.
⇒ Calculate missing sides where the scale factor is unknown.
⇒ Identify where shapes are similar and a scale factor can be found.

Solve problems involving unequal sharing…

⇒ Draw bar models to represent problems visually.
⇒ Use language of ratio and proportion to establish given parts.
⇒ Use given ratios or proportions in order to calculate missing parts or wholes or ratios.
⇒ Use knowledge of ratio and proportion, and of scaling, to calculate different amounts from given amounts e.g. scaling a recipe to feed 4 people rather than 6.

STEM SENTENCES

- 'Ratio is where we compare two parts of a whole.'
- 'Proportion is a part of the whole.'
- 'A shape is only similar if the sides and angles are in proportion to each other.'
- 'For every…….there are…..'

KEY TERMINOLOGY

- **Part**
- **Whole**
- **Fraction**
- **representation**
- **Model**

COMMON MISCONCEPTIONS

- Children may record ratios the wrong way round e.g. when comparing 3 yellow counters and 2 red counters. 'The ratio of yellow to red is 2:3.'
- Children may misuse addition in proportional problems. For example, if for every 1 white chocolate there are 2 milk chocolates, children may assume that for every 21 white chocolates there are 22 milk chocolates.
- If the number of red counters to yellow counters changes to 4 red and 6 yellow , the ratio is no longer 2:3.
- Children may think two shapes are similar because they are the same type of shape (both rectangles, for example) or have the same number of sides.
- Children may add scale rather than calculate.
- Thinking that if a shape is enlarged it always gets larger in size, not realising that a shape can be enlarged by a scale factor of ½ and therefore get smaller.
- If shapes are enlarged they can rotate or change position.

KEY VOCABULARY

⇒ **Scale** – a ratio between two sets of measurements.
⇒ **Scale factor** – a value showing the amount of enlargement.
⇒ **Ratio** – comparing two parts of a whole
⇒ **Proportion** – a part of the whole
⇒ **In proportion** – related to something else

New Learning | Prior Learning

TEACH IT: ALGEBRA

YEAR 6

KEY OBJECTIVES

- Use simple formulae.
- Generate and describe linear number sequences.
- Express missing number problems algebraically.
- Find pairs of numbers that satisfy an equation with two unknowns.
- Enumerate possibilities of combinations of two variables.

POSSIBLE TEACHING SEQUENCE

Use simple formulae.

⇒ Know what is meant by the term formulae.
⇒ Understand that letters in a formula can be used to represent any given value.
⇒ Substitute given values into the place of the letters in the formula.
⇒ Solve formulas, using knowledge of inverse & balancing (represent problems on a scale or bar model).
⇒ Recognise common formulas such as area and volume, or formulas linked to cooking

Ge**nerate and describe…**

⇒ Understand what is meant by term and rule.
⇒ Identify a pattern in a linear sequence & continue pattern forwards & backwards.
⇒ Identify given steps in a linear sequence and relate to a times table.
⇒ Identify the difference between a times table and the linear sequence.
⇒ Use this to generate a rule for the sequence.
⇒ Continue the sequence with the given rule.
⇒ Calculate any given term in a sequence.

Express missing number…

⇒ Understand that a letter can be used to represent any given value.
⇒ Replace a letter with a given value and calculate the answer within an expression.
⇒ Collect like terms together (e.g. all the as) and represent this with a number followed by the letter to show there are so many lots of this term (e.g. a + a + a + a could be written as 4a which means 4 x a).
⇒ Use knowledge of collecting terms to make an expression as simple as possible.
⇒ Read a problem and express algebraically as an expression.
⇒ Know that an expression does not have an answer until a value is given for the letter.

Find pairs… Enumerate possibilities...

⇒ Recognise that there can be two unknowns in an equation.
⇒ Represent problem visually with a bar model or scales.
⇒ Know that where there is an expression such as 2a, there are two equal parts.
⇒ Know that where letters are different, the value of each letter is different.
⇒ Explore using counters and mathematical facts what the possibilities could be.
⇒ Recognise that there could be more than 1 possibility for each value & record all of these systematically.

STEM SENTENCES

- 'When we do not know the value, we can use a letter.'

KEY TERMINOLOGY

- **Input**
- **Output**
- **Factor**
- **Product**
- **Multiple**
- **Express**
- **Expression**
- **Equation**
- **Formula**
- **Pattern**
- **Sequence**
- **Rule**
- **Represent**
- **Formulae**
- **Substitute**
- **Value**
- **Algebraic expressions**
- **Function machine-one-step and two-step.**
- **Integer**
- **Simplify**
- **Values**
- **Satisfy the equation**
- **Trial and improvement**

COMMON MISCONCEPTIONS

- Children may read and misunderstand a multiplicative number sequence as an additive one that adds a different number each time.
- Children may state that the rule for calculating the number from the term in this sequence is + 3, + 6, + 9, + 12, etc.
- May think that all patterns have to start at zero.
- Not understanding that term means the position in a sequence.
- May forget to use brackets in their rules so the rule produces a different value.
- Not recognising that 2y means 2 x y and thinking it means 2 + y.
- Thinking that expressions such as 4x + 5 is the same as 9x.
- When solving equations such as 36 – x = 23, children may solve the incorrect inverse calculation, calculating 23 + 36 instead of 36 – 23.
- Thinking that the order of function machines doesn't matter in a 2-step function machine.

KEY VOCABULARY

⇒ **Expression** – a mathematical statement that contains letters, numbers and symbols
⇒ **Equation** - a mathematical statement with an equals sign
⇒ **Formula** – a mathematical rule to show the relationship between a calculation and an answer
⇒ **Term –** a single number or variable or numbers and variables multiplied together.
⇒ **Variable-**a symbol for a number not yet known, sometimes a letter.
⇒ Integer-a positive or negative number or zero-not a fraction or decimal fraction.

New Learning | Prior Learning

TEACH IT: MEASURE

YEAR 6

KEY OBJECTIVES

- Use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places
- Convert between different units of metric measure e.g. kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre).
- Convert between miles and kilometres
- Understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints.
- Recognise that shapes with the same areas can have different perimeters and vice versa.
- Calculate the area of parallelograms and triangles.
- Calculate, estimate & compare volume of cubes & cuboids using standard units, including cubic centimetres (cm3) and cubic metres (m3), and extending to other units e.g. mm3 and km3.
- Recognise when it is possible to use formulae for area and volume of shapes.
- Measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres.
- Calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm2) and square metres (m2) and estimate the area of irregular shapes.
- Estimate volume e.g. using 1 cm3 blocks to build cuboids (including cubes)] and capacity e,g, using water]

POSSIBLE TEACHING SEQUENCE

Use, read, write and convert...

⇒ Know what units of measure to use to calculate dimensions of given objects, liquids, spaces etc.

⇒ Identify the most suitable unit of that measure e.g. mm, cm or m.

⇒ Know facts from 'know it' pages to convert quickly between different measures.

⇒ Apply knowledge of x and ÷ by 10, 100, 1000 to convert between measures.

Convert between miles...

⇒ Understand the difference between metric and imperial.

⇒ Know that for every 5 miles, there are 8km.

⇒ Represent a given number of miles and km in a bar model to see connection.

⇒ Use knowledge of scaling to convert between miles and km.

⇒ Use line graphs to calculate approximate miles and km conversions.

Recognise that shapes...

⇒ Know what is meant by area and perimeter.

⇒ Know how to calculate the area and perimeter of a shape.

⇒ Given a number of cm squares, create different shapes and calculate the perimeters, recognising the relationship between perimeter and area.

⇒ Begin to use knowledge of factor pairs to determine measurements for different sides of rectangles etc that may give the same area but a different perimeter.

⇒ Explore with simple line drawings how to make shapes with the same perimeter and calculate the area.

⇒ Begin to use knowledge of factor pairs to construct rectangles that will have the same perimeter but a different area.

Calculate the area of parallelograms...

⇒ Recognise the relationship between triangles and rectangles.

⇒ Use relationship to determine how we can calculate the area of triangles.

⇒ Use the formula 1/2b x h

⇒ Recognise the relationship between parallelograms and rectangles, distinguishing carefully between height and width.

⇒ Use relationship to determine how we can calculate the area of parallelograms.

⇒ Use the formula h x l

Calculate, estimate and compare volume of cubes...

⇒ Distinguish between volume and capacity.

⇒ Recognise when a shape has a volume.

⇒ Understand what is meant by volume by using cubes to build different 3D shapes and counting these to calculate the volume.

⇒ Recognise that cubes/cuboids have a depth, height and width.

⇒ Learn the formula for calculating volume & apply, recording accurately with cm3.

⇒ Extend to other measurements e.g. mm3, km3 etc.

Recognise when it is possible...

⇒ Know how to calculate the area of a rectangle/square/triangle/parallelogram and recognise this as a formula.

⇒ Recognise where a compound shape can be broken down into regular shapes (listed above) where a formula can be used to calculate the area.

⇒ Recognise where a compound 3D shape can be broken down into cubes & cuboids to calculate the volume.

STEM SENTENCES

- 'To find the area of a rectangle times the length by the width e.g. Area=l x w
- 'To find the area of a triangle, half the base and times by the height.'
- 'To find the area of a parallelogram, times the base by the height.'
- 'To calculate the volume of cubes and cuboids, multiply width by height by depth.'
- '5 miles is approximately 8km.'
- 'To convert km / kg / l to m /g / ml multiply by 1000.'
- 'To convert m/ g / ml to km / kg / l divide by 1000.'

KEY TERMINOLOGY

· Mass · Weight · Scale · Length · Volume · Capacity · Perimeter · Roman numerals · Time · Noon · Leap year · Increments/divisions · Morning · Afternoon · Midnight · a.m. · p.m. · Calendar · Distance · Area · Analogue · Digital · Standard units · Non-standard units · width · height · depth · base ·miles · kilometres · metric · imperial · pounds · ounces ·feet · inches ·gallons · pints · dimension

COMMON MISCONCEPTIONS

- Not x/÷ by 10/100/1000 correctly when converting measures or not seeing the link between converting measures & x/÷ by 10/100/1000.
- May think that a km is longer than a mile because the ratio is 5:8, therefore assuming that the 8 means a km is longer.
- May think that because two shapes have the same area, they must be equal in dimensions.
- Confusing area and perimeter.
- Calculating the area of a triangle or parallelogram by using a length of a side rather than the height.
- Not recognising the height of triangles and parallelograms when they are in different orientations.
- Not counting the cubes that they cannot see when counting cubes to find volume.

KEY VOCABULARY

⇒ **Capacity** –the amount a container or object can hold, (measured in ml/l).

⇒ **Volume**– amount of solid space occupied by an object (measured in cm^3).

⇒ **Perimeter**-the distance around the outside of a 2D shape.

⇒ **Area**-the amount of space a shape covers.

New Learning | Prior Learning

TEACH IT: GEOMETRY-1

YEAR 6

KEY OBJECTIVES

- Draw 2-D shapes using given dimensions and angles.
- Know that angles are measured in degrees: estimate and compare acute, obtuse and reflex angles.
- Draw given angles and measure them in degrees.
- Identify:
  - angles at a point and one whole turn- 360°;
  - angles at a point on a straight line and ½ a turn;
  - other multiples of 90°.
- Recognise, describe and build simple 3-D shapes, including making nets.
- Identify 3D shapes, including cubes and cuboids from 2D representations.
- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons.
- Use the properties of rectangles to deduce related facts and find missing lengths and angles.
- Distinguish between regular and irregular polygons based on reasoning about equal sides and angles.

POSSIBLE TEACHING SEQUENCE

Draw 2D shapes…

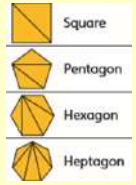
⇒ Know how many degrees in an acute, obtuse, right and reflex angle, and be able to identify them in a range of shapes.
⇒ Know how to use a protractor accurately to measure & draw angles.
⇒ Know how to use a ruler correctly to measure lines.
⇒ Draw a base line and measure given angles from it, making small notations to show the direction the next line must be travelling from.
⇒ Draw lines from the corners of the original line using the notations created previously to draw lines in the correct orientation.
⇒ Construct shapes from representations that have been scaled down.

Recognise, describe and build...

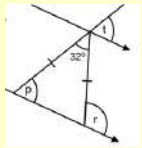
⇒ Know the terminology for 3D shapes: vertices, edges, faces.
⇒ Know that 3D shapes have depth and are constructed of 2D shapes.
⇒ Recognise the properties of different 3D shapes.
⇒ Identify given nets that could make a 3D shape from different orientations & recognise that different nets can make the same shape.
⇒ Construct 3D shapes from given nets; construct their own nets to create 3D shapes.
⇒ Solve visualisation problems that involves orientating 3D shapes in different positions and recording new markings/positions.

Compare and classify...

⇒ Recognise regular and irregular 2D shapes from number of sides & corners (vertices).
⇒ Identify lines of symmetry, parallel/perpendicular lines & angles within 2D shapes.
⇒ Identify facts such as a triangle can never have two obtuse angles etc.
⇒ Understand that the angles in a triangle add up to 180° by cutting off the corners and rearranging into a straight line.
⇒ Use the above knowledge to calculate missing angles in triangles.
⇒ Understand that the angles in a quadrilateral add up to 360° by cutting off the corners and rearranging into a full rotation.
⇒ Use the above knowledge to calculate missing angles in quadrilaterals.
⇒ Show how regular polygons can be separated into triangles; work out how many triangles are in a polygon by joining corners together; use this to calculate what the angles in a regular polygon add up to & the value of each individual angle.



⇒ Apply knowledge of angles in triangles, quadrilaterals and polygons to more in depth problems that involve several 2D shapes and straight lines.



STEM SENTENCES

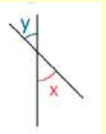
- 'All the angles in a triangle total 180°.'
- 'All the angles in a quadrilateral total 360°.'
- 'A regular polygon is composed of triangles.'
- 'An isosceles triangle has two angles that are equal.'

KEY TERMINOLOGY

- **Acute**
- **Obtuse**
- **Regular**
- **Irregular**
- **Polygon**
- **Vertices**
- **Faces**
- **Base**
- **Edges**
- **Reflection**
- **Translation**
- **Parallel**
- **Protractor**
- **Perpendicular**
- **Diagonal**
- **Coordinate**

COMMON MISCONCEPTIONS

- Not counting hidden vertices, faces and edges on a 2D representation of a 3D shape.
- Reading the wrong scale when measuring angles.
- Measuring acute angle instead of reflex e.g.
- Not recognising reflex angles within irregular shapes e.g.
- Not recognising straight lines within shapes or around a point etc.
- Thinking that any opposite angles are equal, instead of just those on intersecting straight lines.



- Not recognising opposite equal angles because they are labelled differently.
- Not recognising that angles labelled with the same letter must be equal in value.

KEY VOCABULARY

⇒ **Prism**— a 3D shape with two parallel faces that are the same 2D shape. All the other faces are rectangles.
⇒ **Polygon** – a 2D shape with 3 or more straight sides.
⇒ **Intersect** – to cross over each other.
⇒ **Regular** – a shape with all sides and angles equal.
⇒ **Irregular** – a shape where sides and angles are different sizes and lengths.

New Learning | Prior Learning

TEACH IT: GEOMETRY-2

YEAR 6

KEY OBJECTIVES

- Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius
- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles.
- Know that angles are measured in degrees: estimate and compare acute, obtuse and reflex angles.
- Draw given angles and measure them in degrees.
- Identify:
  - angles at a point and one whole turn-360°;
  - angles at a point on a straight line and ½ a turn;
  - other multiples of 90°.
- Describe positions on the full coordinate grid (all four quadrants)
- Draw and translate simple shapes on the coordinate plane, and reflect them in the axes.
- Identify, describe and represent the position of a shape following a reflection or translation using the appropriate language and know that the shape has not changed.

POSSIBLE TEACHING SEQUENCE

Illustrate and name parts of circles…

⇒ Recognise circles in different representations, distinguishing between a circle and an oval.
⇒ Identify and name the parts of a circle.
⇒ Recognise the link between the diameter & radius-both must connect with the centre point.
⇒ Use the knowledge to recognise that a radius is always half the diameter and the diameter is double the radius.
⇒ Calculate radius and diameters from given values.

Recognise angles where they meet…

⇒ Recognise straight lines & full rotations in a variety of representations e.g. attached to shapes, on a group of several lines intersecting/joining, on parallel lines intersected by other lines.
⇒ Understand what it means for two angles to be vertically opposite.
⇒ Recognise vertically opposite angles in a range of representations
⇒ Calculate vertically opposite angles.
⇒ Apply knowledge of full rotations to determine the remaining two opposite angles, remembering to divide the remaining total by 2 (if required).

Describe positions on the full coordinate grid…

⇒ Count forwards and backwards across 0, including negative numbers.
⇒ Relate knowledge of negative numbers on a number line to construct 4 quadrant grids.
⇒ Know that when we read coordinates, we read x then y.
⇒ Plot and read in all 4 quadrant, recording coordinate (x, y).

Draw and translate simple shapes…

⇒ Read and write coordinates.
⇒ Join given coordinates to plot a simple shape.
⇒ Know the prefix trans means across & therefore translate means to move across.
⇒ Count the jumps, not the squares, to successfully translate a shape.
⇒ Know what is meant by a reflection & mirror image, reflecting shapes accurately.
⇒ Understand that both the x and y axis can act as a mirror line.
⇒ Use a mirror to aid with simple reflections.
⇒ Use points/locations/numbers of a squares on the quadrant grid to help them plot a reflection, remembering it must be a mirror image.
⇒ Predict missing coordinates by applying their knowledge of shape.

STEM SENTENCES

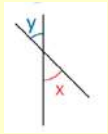
- 'All the angles in a triangle total 180°.'
- 'All the angles in a quadrilateral total 360°.'
- 'When two straight lines intersect, vertically opposite angles are equal.'
- 'Adjacent angles on a straight line total 180°.'
- 'The radius is always half the diameter.'
- 'The diameter is always double the radius.'
- 'The diameter must travel through the centre of the circle.'
- 'The radius must touch the centre of the circle.'
- 'When we read coordinates, we read x then y.'
- 'To translate a shape, count the jumps.'

KEY TERMINOLOGY

- **Acute**
- **Obtuse**
- **Regular**
- **Irregular**
- **Polygon**
- **Vertices**
- **Faces**
- **Base**
- **Edges**
- **Reflection**
- **Translation**
- **Parallel**
- **Protractor**
- **Perpendicular**
- **Diagonal**
- **Coordinate**

COMMON MISCONCEPTIONS

- Reading the wrong scale when measuring angles.
- Not recognising straight lines within shapes or around a point etc.
- Thinking that any opposite angles are equal, instead of just those on intersecting straight lines.
- Not recognising opposite equal angles because they are labelled differently.
- Not recognising that angles labelled with the same letter must be equal in value.
- Counting squares not jumps when translating
- Translating, instead of flipping a shape around a mirror line.
- Not recognising that the radius/diameter can be at any point on the circumference, as long as it travels through the centre.
- Not realising that the radius/diameter MUST travel through the centre and therefore creating chords instead.
- Doubling the diameter to calculate the radius or halving the radius to find the diameter (incorrect understanding of terminology).



KEY VOCABULARY

⇒ **Radius –** the distance from the centre of the circle to the circumference
⇒ **Diameter** – a straight line passing through the centre of the circle to touch both sides of the circumference
⇒ **Circumference** – the distance around the edge of the circle.
⇒ **Chord** – a straight line joining two points on the circumference of a circle
⇒ **Segment** – a section of a circle bound by a chord.
⇒ **Vertically opposite** – a pair of angles directly opposite each other due to the intersection of two straight lines.

New Learning | Prior Learning

TEACH IT: STATISTICS

YEAR 6

KEY OBJECTIVES

- Interpret and construct pie charts and line graphs and use these to solve problems.
- Solve comparison, sum and difference problems using information presented in a line graph
- Calculate and interpret the mean as an average.

POSSIBLE TEACHING SEQUENCE

Interpret and construct pie charts.

⇒ Understand what is meant by discrete data and that a pie chart can represent this.
⇒ Identify pie charts in a range of interpretations and with a range of values, including decimals.
⇒ Relate a pie chart to a circle, fractions and degrees, and to being 100% of a sample.
⇒ Interpret pie charts, being able to ask and answer a range of one step and two step problems.
⇒ Record the number in a sample and the total sample as a fraction e.g. if 30 people liked mint, then this is 30/60. Recognise that 30/60 is the same as half and use knowledge of fractions to construct parts of a pie chart.

Flavour	Number
Mint	30
Chocolate	20
Vanilla	10

⇒ Where a sample cannot easily be related to fractions: divide 360° by the total sample to determine how many degrees each person in the sample represents.
⇒ Multiply the degrees by the number in each group within a sample.
⇒ Use a protractor to construct the segments of a pie chart, ensuring that the degrees of each segment total 360°.

Construct line graphs…

⇒ Understand what is meant by continuous data and know that line graphs can represent this.
⇒ Identify line graphs in a range of interpretations and with a range of values, including decimals.
⇒ Interpret line graphs, being able to ask and answer a range of one step and two step problems, and make estimates by using a line used to join two points.
⇒ Plot axis, ensuring intervals are equally spaced apart.
⇒ Plot the points from given data.
⇒ Join the points using a ruler to create a straight line between each points.
⇒ Interpret the data.
⇒ Use line graphs to convert between miles and km.

Calculate and interpret the mean…

⇒ Understand the terms mean and average can be used interchangeably.
⇒ Understand why it can be useful to find the average and establish how this data is used.
⇒ Place all the points on a number line to visually see where the middle of the data may fall.
⇒ Use the formula for calculating the mean: add up all the values in a data set and divide by how many there are.
⇒ Know when it is appropriate to find the mean.

STEM SENTENCES

- 'To calculate the mean, add up all the values and divide by how many there are.'
- '50 people in a sample of 60 liked chocolate. I can write this as 50/60.'
- 'X runs along the bottom, y goes up the side.'
- 'The mean is the total divided by the number of items.'

KEY TERMINOLOGY

- **Interpret**
- **Represent**
- **Key**
- **Scale**
- **Representation**
- **Data**
- **Axis**
- **Interval**
- **Data set**
- **More**
- **Greatest**
- **Set**
- **Segment**
- **Discrete data**
- **Continuous data**

COMMON MISCONCEPTIONS

- Not understanding the link between degrees in a circle and pie charts.
- Thinking that the greater the number of groups, the greater the mean.
- Not recognising that data can be represented in different ways e.g. on a pie chart or on a bar chart.
- Mistaking the number of segments on a pie chart for the denominator of a fraction e.g.  **Q:** What fraction of the pie chart preferred summer? **A:** ⅓ even though this is clearly incorrect.
- Leaving sections of a pie chart blank instead of recognising that all the segments/fractions together must create a full circle/a whole one.
- Confusing degrees in a circle and percentage. They may think the number of degrees in a circle is 100 because the whole circle is 100%.

KEY VOCABULARY

⇒ **Line graph**– uses lines to join points that represent data
⇒ **Pie Chart** – a graph using a divided circle where each segment represents a percentage of the total.
⇒ **Mean** - the total of all the scores or amounts, divided by, how many scores or amounts there were.
⇒ **Average** – a measure used to find the middle of a data set.

New Learning | Prior Learning

YEAR 6

APPLY IT: PROBLEM-SOLVING & REASONING

PROBLEM-SOLVING AND REASONING SHOULD BE APPLIED THROUGHOUT ALL TEACHING NOT JUST WITHIN ISOLATED LESSONS.

PROBLEM-SOLVING AND REASONING.

The following strategies are a very powerful way of developing pupils' problem-solving and reasoning skills and can be used flexibly across all strands of maths.

- **Spot the mistake/Which is different?**
- **True or false?**
- **What comes next?**
- **Do, then explain.**
- **Make up an example/Write more statements/Create a question/Another and another.**
- **Possible answers/other possibilities.**
- **Missing numbers/Missing symbols/Missing information.**
- **Working backwards/Use of inverse/ Undoing/Unpicking.**
- **Hard and easy questions/Order from easiest to hardest.**
- **What else do you know?/Use a fact.**
- **Fact families.**
- **Convince me/Prove it/Generalising/Explain thinking**
- **Connected calculations.**
- **Make an estimate/Size of an answer.**
- **Always, sometimes, never.**
- **Making links/Application.**
- **Can you find?**
- **Odd one out.**
- **Complete/continue the pattern.**
- **Ordering.**
- **The answer is…**
- **Visualising**
- **Answer free zone.**
- **Justify.**

PROBLEM-SOLVING AND REASONING EXAMPLES FOR YEAR 6

Place Value

Eva has ordered eight 6-digit numbers.

The smallest number is 345,900

The greatest number is 347,000

All the other numbers have a digit total of 20 and have no repeating digits.

What are the other six numbers?

Can you place all eight numbers in ascending order?

Calculations

Put brackets into these number sentences so they are true:

15 + 7 x 4 = 88

18 – 9 – 2 = 11

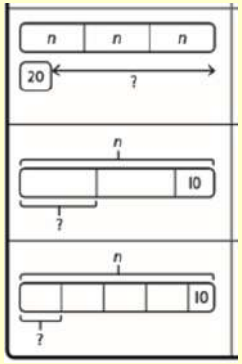
8 x 4 – 2 x 5 = 22

16 ÷ 8 – 4 = 4

9 + 12 ÷ 7 – 4 = 7

Algebra

Write an expression for each ?



Fractions

On Saturday Lorna read $^{2}/_{5}$ of her book. On Sunday she read the other 90 pages to finish her book. How many pages are in the book?

Decimals & Percentages

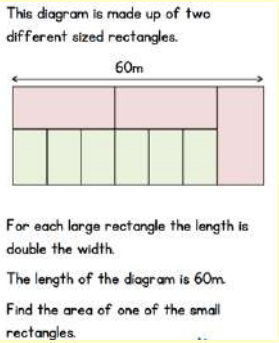
Complete the missing numbers.

50% of 40 = ____% of 80

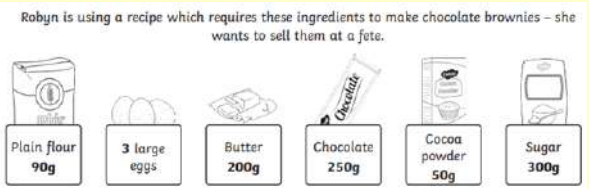
___% of 40 = 1% of 400

10% of 500 = ____% of 100

Measure

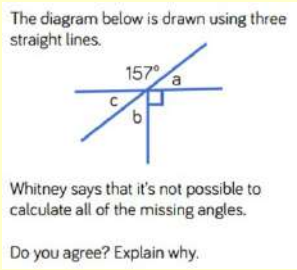


Ratio & Proportion



The above ingredients makes 10 brownies. How much flour would you need for 6 brownies?

Geometry-Shape



Geometry-Position & Direction