Knowledge Grid Mathematics- Year 10

Week From 39-week plan	**Tier 3 Vocabulary with key definitions** **Tier 3 words** are subject-specific, used within a particular field. For example, the language of scientists, mathematicians, historians, and literary critics. For maths, this includes words like 'denominator', while science lessons might require learners to understand 'homeostasis'.	**Substantive Knowledge** The specific, factual concepts needed for the topic or subject. (Detail for each included in lesson resources)	**Common Misconceptions** Any idea that students do not accurately understand when studying this content, concept or subject. (Updated live by teachers when misconceptions occur)
1 2 3	**<u>Congruency, Similarity and Enlargement</u>** **Similar** - When one shape can become another after a resize, flip, slide or turn. **Corresponding** - When two lines are crossed by another line (which is called the Transversal), the angles in matching corners are called corresponding angles. **Scale factor** - The ratio of the length in a drawing (or model) to the length on the real thing **Ratio** - A ratio shows the relative sizes of two or more values.	How to enlarge a shape by a positive integer scale factor How to enlarge a shape by a fractional scale factor How to enlarge a shape by a negative scale factor Identify similar shapes Work out missing sides and angles in a pair given similar shapes How to use parallel line rules to work out missing angles Establish a pair of triangles are similar	Students don't enlarge all the sides by the same amount Students think that enlargement only means a shape getting larger Students don't see the difference in scale factor when it comes

	Ratios can be shown in different ways: • using the ":" to separate example values • using the "/" to separate one value from the total • as a decimal, after dividing one value by the total • as a percentage, after dividing one value by the total **Orientation** - the action of orienting someone or something relative to the points of a compass or other specified positions **Origin** - The starting point. Sometimes written as the capital letter **O** • On a number line it is 0, • On a two-dimensional graph it is where the X axis and Y axis cross, such as on the graph here: • In three dimensions it is the point (0, 0, 0) where the x, y and z axes cross: **Corresponding** - When two lines are crossed by another line (which is called the Transversal), the angles in matching corners are called corresponding angles **Congruent** - The same shape and size (but we are allowed to flip, slide or turn)	Explore areas of similar shapes Explore volumes of similar shapes Solve mixed problems involving similar shapes How to understand the difference between congruence and similarity How to understand and use conditions for congruent triangles How to prove a pair of triangles are congruent	to area and volume Students don't see the similarity when shapes have been rotated
4	**<u>Trigonometry</u>**	How to explore ratio in similar right-angled triangles	Students label the sides the

5 6	**Corresponding** - When two lines are crossed by another line (which is called the Transversal), the angles in matching corners are called corresponding angles. **Scale factor** - The ratio of the length in a drawing (or model) to the length on the real thing **Ratio** - A ratio shows the relative sizes of two or more values. Ratios can be shown in different ways: • using the ":" to separate example values • using the "/" to separate one value from the total • as a decimal, after dividing one value by the total • as a percentage, after dividing one value by the total **Enlarge** - To make larger, or smaller (if the scale factor is fractional) **Hypotenuse** - The side opposite the right angle in a right-angled triangle. It is also the longest side of the right-angled triangle. **Adjacent** - Lying next to each other.	How to work fluently with the hypotenuse, opposite and adjacent sides How to use the tangent ratio to find missing side lengths How to use the sine and cosine ratio to find missing side lengths How to use sine, cosine and tangent to find missing side lengths How to use sine, cosine and tangent to find missing angles How to calculate sides in right-angled triangles using Pythagoras' Theorem How to select the appropriate method to solve right-angled triangle problems How to work with key angles in right-angled triangles How to use trigonometry in 3-D shapes How to use the formula $\mathbf{1\ 2}\ \boldsymbol{ab}\ \mathbf{sin}\ \boldsymbol{C}$ to find the area of a triangle	wrong way (especially when the triangle is rotated) Students don't understand how to rearrange the trig equations (this needs to be taught prior to teaching trig) Students use the wrong ratio (linked to finding the wrong sides) Students don't understand which one to use when (only sides = Pythagoras Only side but one angle given = trig (missing side)

	Tangent - A line that just touches a curve at a point, matching the curve's slope there **Inverse** - means the opposite in effect. The reverse of.	How to understand and use the sine rule to find missing lengths How to understand and use the sine rule to find missing angles How to understand and use the cosine rule to find missing lengths How to understand and use the cosine rule to find missing angles How to Choose and use the sine and cosine rules	Finding missing angle = trig (inverse) Students get the sine rule the wrong way round and then have to rearrange the equation and as a result make a mistake
7 8	**<u>Representing solutions of equations and inequalities</u>** **Variable** - A quantity that can take on a range of values, often denoted by a letter, x, y, z, t, … etc. Gradient **Inverse** - means the opposite in effect. The reverse of **Constant** - A fixed value. In Algebra, a constant is a number on its own, or sometimes a letter such as a, b or c to stand for a fixed number.	How to understand the meaning of a solution How to form and solve one-step and two-step equations How to form and solve one-step and two-step inequalities How to show solutions to inequalities on a number line Interpret representations on number lines as inequalities How to represent solutions to inequalities using set notation How to draw straight line graphs	

	Equation - A mathematical statement showing that two expressions are equal. The expressions are linked with the symbol = **Term** - is any single number or variable **Expression** - Numbers, symbols and operators (such as + and ×) grouped together that show the value of something. **Inequalities** - the relationships between two expressions which are not equal to one another. The symbols used for inequalities are <, >, ≤, ≥ and ≠. **Notation** - A system of symbols used to represent special things **Gradient** - A measure of the slope of a line **Intersection** – Geometry: Where lines cross over (where they have a common point). Sets: only the elements that are in both sets	How to find solutions to equations using straight line graphs How to represent solutions to single inequalities on a graph How to represent solutions to multiple inequalities on a graph How to form and solve equations with unknowns on both sides How to form and solve inequalities with unknowns on both sides How to form and solve more complex equations and inequalities How to solve quadratic equations by factorisation How to solve quadratic inequalities in one variable	
9 10 11	**<u>Simultaneous equations</u>** **Variable** - A quantity that can take on a range of values, often denoted by a letter, x, y, z, t, … etc. Gradient	How to understand that equations can have more than one solution How to determine whether a given (x, y) is a solution to a pair of linear simultaneous equations	

	Inverse - means the opposite in effect. The reverse of **Constant** - A fixed value. In Algebra, a constant is a number on its own, or sometimes a letter such as a, b or c to stand for a fixed number. **Equation** - A mathematical statement showing that two expressions are equal. The expressions are linked with the symbol = **Term** - is any single number or variable **Expression** - Numbers, symbols and operators (such as + and ×) grouped together that show the value of something **Factor** - When a number, or polynomial in algebra, can be expressed as the product of two numbers or polynomials, these are factors of the first **Multiple** - For any integers a and b, a is a multiple of b if a third integer c exists so that a = bc	How to solve a pair of linear simultaneous equations by substituting a known variable Solve a pair of linear simultaneous equations by substituting an expression How to solve a pair of linear simultaneous equations using graphs How to solve a pair of linear simultaneous equations by subtracting equations How to solve a pair of linear simultaneous equations by adding equations How to use a given equation to derive related facts How to solve a pair of linear simultaneous equations by adjusting one equation How to solve a pair of linear simultaneous equations by adjusting both equations How to form a pair of linear simultaneous equations from given information How to form and solve pair of linear simultaneous equations from given information Determine whether a given $(\boldsymbol{x}, \boldsymbol{y})$ is a solution to both a linear and quadratic equation Solve a pair of simultaneous	

		equations (one linear, one quadratic) using graphs Solve a pair of simultaneous equations (one linear, one quadratic) algebraically Solve a pair of simultaneous equations involving a third unknown	
12	Assessment week		
13 14	**<u>Angles and Bearings</u>** **Covert** - Changing from one quantity or measurement to another **Ratio** - A ratio shows the relative sizes of two or more values. Ratios can be shown in different ways: • using the ":" to separate example values • using the "/" to separate one value from the total • as a decimal, after dividing one value by the total • as a percentage, after dividing one value by the total **Similar** - When one shape can become another after a resize, flip, slide or turn. **Corresponding** - When two lines are crossed by another line (which is called the Transversal), the angles in matching corners are called corresponding angles.	How to use cardinal directions and related angles How to draw and interpret scale diagrams Understand and represent bearings How to measure and read bearings Make scale drawings using bearings How to calculate bearings using angles rules How to solve bearings problems using Pythagoras and trigonometry How to solve bearings problems using the sine and cosine rules	Students do not understand what scales mean, for example 1:50000 Students do not understand that when you convert into a larger unit of measurement you need to divide by the unit conversion, not multiply Students do not to 3-figures Students use the wrong side of the

	Bearing - **Three-Figure Bearings**: The angle in degrees measured clockwise from North. **Construct** – form an idea or theory, or to build something **Alternate** - When two lines are crossed by another line (the Transversal), a pair of angles • on the outer side of those two lines • but on opposite sides of the transversal		protractor when measuring bearings
15 16	**<u>Working with Circles</u>** **Radius** - The distance from the centre to the circumference of a circle. It is half of the circle's diameter. **Diameter** - The distance from one point on a circle through the center to another point on the circle. It is also the longest distance across the circle. And it is twice the radius. **Chord** - A line segment connecting two points on a curve. **Tangent** - A line that just touches a curve at a point, matching the curve's slope there. (From the Latin *tangens* touching, like in the word "tangible".)	How to recognise and label parts of a circle How to calculate fractional parts of a circle How to calculate the length of an arc How to calculate the area of a sector How to use circle theorem: Angles at the centre and circumference How to use circle theorem: Angles in a semicircle How to use circle theorem: Angles in the same segment	Students use the diameter instead of the radius or vice versa Students use the wrong circle theorem Students substitute the wrong lengths into the wrong formulae

	Sector - A "pie-slice" part of a circle - the area of a circle between two radiuses and the arc connecting them. **Segment** - The smallest part of a circle made when it is cut by a line. **Arc** - Part of the circumference of a circle. **Proportion** - Proportion says that two ratios (or fractions) are equal. **Subtend** - To take up the side opposite an angle or arc. **Circumference** - The distance around a circle (or any curvy shape). **Cyclic** - A quadrilateral with every vertex (corner point) on a circle's circumference **Frustrum** - Usually a pyramid or cone with the top cut off flat.	How to use circle theorem: Angles in a cyclic quadrilateral Understand and use the volume of a cylinder and cone Understand and use the volume of a sphere Understand and use the surface area of a sphere Understand and use the surface area of a cylinder and cone How to solve area and volume problems involving similar shapes	
17 18	**<u>Vectors</u>** **Magnitude** - The size of something. **Scalar** - A number on its own (used when dealing with vectors or matrices).	How to understand and represent vectors Use and read vector notation How to draw and understand vectors multiplied by a scalar	Students get the vectors the wrong way round Students draw a line between

	Multiplier - The number that you are multiplying by. **Resultant** – the vector sum of all individual vectors **Parallel** - Always the same distance apart and never touching. **Collinear** - When three or more points lie on a straight line.	How to draw and understand addition of vectors How to draw and understand addition and subtraction of vectors How to explore vector journeys in shapes How to explore quadrilaterals using vectors Understand parallel vectors How to explore collinear points using vectors How to use vectors to construct geometric arguments and proofs	the vector movement, to make them look like a fraction Students get the movement the wrong way round
19 20	**<u>Ratios and Fractions</u>** **Equivalent** - Having the same value. Examples: 1 Dollar is equivalent to 100 cents 120 seconds is equivalent to 2 minute **Convert** - To change a value or expression from one form to another. **Unit** - A general term meaning **1** **Proportion** - Proportion says that two ratios (or fractions) are equal. **Gradient** - How steep a line is.	How to compare quantities using a ratio How to link ratios and fractions How to share in a ratio (given total or one part) How to use ratios and fractions to make comparisons How to link ratios and graphs How to solve problems with currency conversion How to link ratios and scales	Students do not put the total of the ratio as the denominator Students get the multiplication and division the wrong way round when doing currency exchange

	Scale - The ratio of the length in a drawing (or model) to the length on the real thing **Bearing** - Three-Figure Bearings: The angle in degrees measured clockwise from North. **Integer** - A number with no fractional part (no decimals). **Variable** - A symbol for a value we don't know yet. It is usually a letter like x or y. **Similar** - When one shape can become another after a resize, flip, slide or turn.	How to use and interpret ratios of the form $1:n$ and $n:1$ How to solve 'best buy' problems How to combine a set of ratios How to link ratio and algebra How to use ratio in area problems How to use ratio in volume problems How to do mixed ratio problems	
21 22	**<u>Percentages and interest</u>** **Equivalent** - Having the same value. **Convert** - To change a value or expression from one form to another. **Multiplier** - The number that you are multiplying by. **Compound -** Where interest is calculated on both the amount borrowed plus previous interest. Usually calculated one or more times per year.	How to convert and compare fractions, decimals and percentages How to work out percentages of amounts (with and without a calculator) How to increase and decrease by a given percentage How to express one number as a percentage of another How to calculate simple and compound interest Repeated percentage change	Students do not multiply by 100 or divide by 100 when converting between percentages and decimals, they normally use 10 Students do not use the multiplier correctly, for example, for an

	Depreciate – goes down (normally linked to money) **Geometric (sequence)** - A sequence made by multiplying by the same value each time.	How to find the original value after a percentage change How to solve problems involving growth and decay How to understand iterative processes How to solve problems involving percentages, ratios and fractions	increase of 3% they often put 1.3 or 0.03. This is the same with decreasing an amount, they often forge tot take it off the 100% before converting it into a decimal.
23 24	**<u>Probability</u>** **Numerator** - The top number in a fraction. **Denominator** - The bottom number in a fraction. **Union** - The set made by combining the elements of two sets. So the union of sets A and B is the set of elements in A, or B, or both. The symbol is a special "U" like this: ∪ **Intersect** - To cross over (have some common point) **Complement** - The Complement of an event is all outcomes that are not the event. **Universal set** - The set that has all elements relevant to our question. Often shown using	Know how to add, subtract and multiply fractions How to find probabilities using equally likely outcomes How to use the property that probabilities sum to 1 How to use experimental data to estimate probabilities How to find probabilities from tables, Venn diagrams and frequency trees How to construct and interpret sample spaces for more than one event How to calculate probability with independent events	Students just add the numerator and denominator together without finding a common denominator. Students use a common denominator however do not find the LCM and also do not simplify at the end Students identify the

	the symbol U. When we are studying integers then the universal set is all the integers. **Product** - The answer when two or more values are multiplied together.	How to use tree diagrams for independent events How to use tree diagrams for dependent events How to construct and interpret conditional probabilities (Tree diagrams) How to construct and interpret conditional probabilities (Venn diagrams and two-way tables)	wrong part of the venn diagram Students to not close the venn with a rectangle around it
25	Assessment		
26 27 28	**<u>Collecting, Representing and Interpreting data</u>** **Sample** - A selection taken from a larger group (the "population") that will, hopefully, let you find out things about the larger group. **Biased** - A systematic (built-in) error which makes all values wrong by a certain amount. **Representative** - very general relationship that expresses similarities (or equivalences) between mathematical objects or structures.	How to understand populations and samples How to construct a stratified sample Primary and secondary data How to construct and interpret frequency tables and frequency polygons How to construct and interpret two-way tables How to construct and interpret line and bar charts (including composite bar charts) How to construct and interpret pie charts	Students do not understand the difference between the definitions

	Proportion - Proportion says that two ratios (or fractions) are equal. **Stratified** – process of dividing the population into smaller sub-groups **Primary** – information that has not undergone any process of manipulation and has been gathered by first-hand sources **Secondary** - data that is not originally collected by a group for a specific purpose, for example, finding out the average cost of cars in a car park by using national statistics **Composite** - A function made of other functions, where the output of one is the input to the other. **Subtend** - To take up the side opposite an angle or arc. **Radius** - The distance from the centre to the circumference of a circle **Sector** - A "pie-slice" part of a circle - the area of a circle between two radiuses and the arc connecting them.	How to criticise charts and graphs How to construct histograms Interpret histograms How to find and interpret averages from a list How to find and interpret averages from a table How to construct and interpret time series graphs How to construct and interpret stem-and-leaf diagrams How to construct and interpret cumulative frequency diagrams How to use cumulative frequency diagrams to find measures How to construct and interpret box plots How to compare distributions using charts and measures How to compare distributions using complex charts and measures	

	Outlier - A value that "lies outside" (is much smaller or larger than) most of the other values in a set of data. **Trend** – a pattern observed in data over a set amount of time **Polygon** - A plane shape (two-dimensional) with straight sides. **Cumulative** - The total of all frequencies so far in a frequency distribution. It is the 'running total' of frequencies. **Interpolation** - Estimating a value inside a set of data points. **Correlation** - When two sets of data are strongly linked together we say they have a High Correlation.	How to construct and interpret scatter graphs How to draw and use a line of best fit How to understand extrapolation	
29 30	**<u>Non-Calculator Methods</u>** **Reciprocal** - The reciprocal of a number is 1 divided by the number **Numerator** - The top number in a fraction. **Denominator** - The bottom number in a fraction.	How to do mental/written methods of integer/decimal addition and subtraction How to do mental/written methods of integer/decimal multiplication and division How to use the four rules of fraction arithmetic How to use exact answers	Students find the multiples instead of the factors or vice versa

	Integer - A number with no fractional part (no decimals). **Recurring** - A decimal number with a digit (or group of digits) that repeats forever. **Infinite** - Without an end. Not finite. **Root** - Where a function equals zero. **Factor** - Numbers we can multiply together to get another number. **Rationalise** - A number that can be made as a fraction of two integers (an integer itself has no fractional part). **Truncate** - Cut off. **Quotient** - The answer after we divide one number by another. **Sum** - The result of adding two or more numbers. **Product** - The answer when two or more values are multiplied together.	How to use rational and irrational numbers (convert recurring decimals here) How to understand and use surds How to calculate with surds How to round to decimal places and significant figures How to estimate answers to calculations How to understand and use limits of accuracy How to use upper and lower bounds How to use number sense How to solve financial maths problems How to break down and solve multi-step problems	
31 32	**<u>Types of number and sequences</u>** **Integer** - A number with no fractional part (no decimals).	How to understand the difference between factors and multiples	

	Factor - Numbers we can multiply together to get another number. **Multiple** - The result of multiplying a number by an integer (not by a fraction). **Intersection** - Geometry: Where lines cross over (where they have a common point). Sets: only the elements that are in both sets **Product** - The answer when two or more values are multiplied together. **Arithmetic (sequence)** - A sequence made by adding the same value each time. **Geometric (sequence)** - A sequence made by multiplying by the same value each time. **Oscillate** - An infinite series where the terms alternate between positive and negative. **Coefficient** - A number used to multiply a variable. Example: 6z means 6 times z, and "z" is a variable, so 6 is a coefficient.	How to understand primes and express a number as a product of its prime factors How to find the HCF and LCM of a set of numbers How to describe and continue arithmetic and geometric sequences How to explore other sequences How to describe and continue sequences involving surds How to find the rule for the n th term of a linear sequence How to find the rule for the n th term of a quadratic sequence	
33	**<u>Indices and roots</u>**	How to use square and Cube numbers	
34		How to calculate higher powers and roots	

	Integer - A number with no fractional part (no decimals). **Root** - Where a function equals zero. **Exponent** - The exponent of a number says how many times to use that number in a multiplication. **Index** - The index of a number says how many times to use the number in a multiplication. **Power** - The power (or exponent) of a number says how many times to use the number in a multiplication.	How to use powers of ten and standard form How to use the addition and subtraction rules for indices How to understand and use the power zero and negative indices How to work with powers of powers How to understand and use fractional indices How to calculate with numbers in standard form	
35	Revision		
36	Trial examinations		
37			
38	**<u>Manipulating expressions</u>**	How to simplify algebraic expressions	Students include the algebraic letter in the coefficient
39	**Coefficient** - A number used to multiply a variable. Example: 6z means 6 times z, and "z" is a variable, so 6 is a coefficient.	How to use identities How to add and subtract simple algebraic fractions	

	Expression - Numbers, symbols and operators (such as + and ×) grouped together that show the value of something. **Power** - The power (or exponent) of a number says how many times to use the number in a multiplication. **Identity** - An equation that is true no matter what values are chosen. **Equivalent** - Having the same value. **Quotient** - The answer after we divide one number by another. **Reciprocal** - The reciprocal of a number is 1 divided by the number	How to add and subtract complex algebraic fractions How to multiply and divide simple algebraic fractions How to multiply and divide complex algebraic fractions How to form and solve equations and inequalities with fractions How to solve equations with algebraic fractions How to represent numbers algebraically How to use algebraic arguments and proof	